E ENGINEERING CONSTRUCTION WEEKLY

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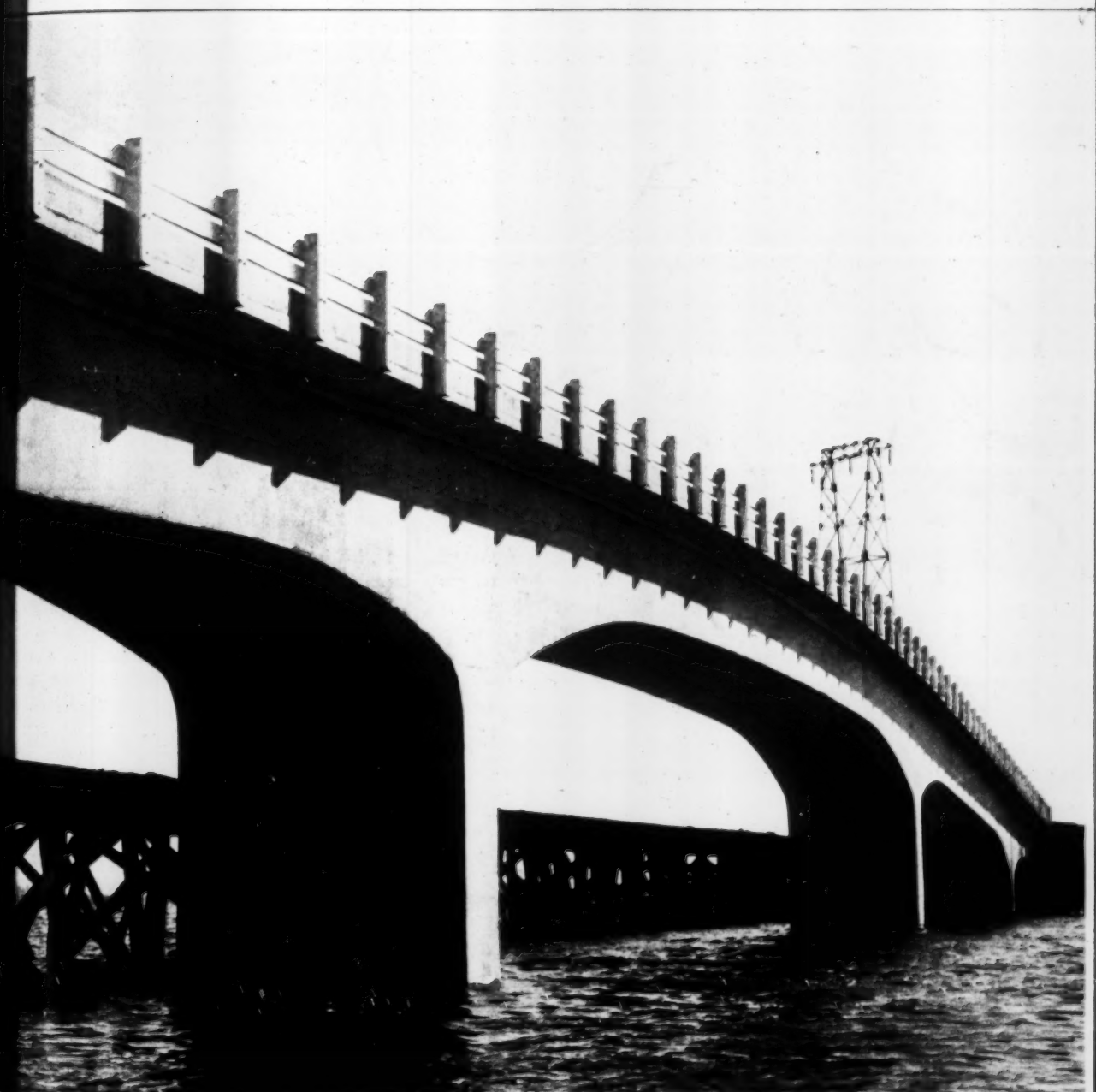
OCT 16 1937

Engineering NEWS-RECORD

October 14, 1937



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NEVER MYOPIC

Always farsighted, Republic Steel today is helping to win important battles for industry. This vigilant policy looks into and senses the needs of the future.

From the world-famous laboratories and the new and modern mills of Republic come unceasingly new steels for new uses—better steels for old uses.

During the past 30 months Republic has appropriated nearly $50,000,000 for new mills and equipment.

Republic acquired Corrigan-McKinney Steel Co., Gulf States Steel Co., Truscon Steel Co., and others. It enlarged blast furnace capacity. It revolutionized pipe manufacture with its electric weld process. It built a new wire mill for the production of electro-galvanized wire and entered the vast farm market. It built the most efficient type of cold-rolled tin plate mill. It developed among other new products heat-treated casing for oil wells and built a new plant to produce it. It strengthened its position as the world's largest manufacturer of alloy steels by expanding its production capacity. And continuing its policy, Republic will soon announce its latest achievement—the largest, fastest and most modern hot and cold continuous strip mill in the world.

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GENERAL OFFICES . . . CLEVELAND, OHIO

Some Must Be Above the Average

LAST JANUARY this page said:

> "It is to be remembered that much of the golden shower that has so colored the closing months of 1936 results from a combination of rapidly growing volume and low costs. That is a happy situation but it cannot last. It never does. * * * It is one thing to net a fine margin on a recovery volume at depression costs. But it will be quite another thing once those costs begin to catch up. Then the unit margin begins to dwindle and the aggregate margin soon melts away, unless the volume is made to grow in proportion.
>
> "Right now the far-sighted executive is planning to control his costs and build his sales during the coming year. He is putting his plant on the most efficient possible basis and he is strengthening his sales and advertising effort for the months ahead. He knows that such effort alone will enable him to maintain the revived earnings that he now welcomes with such enthusiasm."

That statement was intended to foreshadow the next phase of the recovery cycle. We now are in that phase. That is why business has been suffering an attack of chills and fever, which is unpleasant but, if we keep our perspective, not dangerous.

Economic cycles do not swing smoothly. They move, as a rule, by successive jerks. They behave like some drivers—one minute down hard on the accelerator, then down hard on the brakes, according to their moods and what they think they see ahead. That is characteristic of economic democracy. If we don't like it, we have our choice of socialism or fascism, where we rely on economic planning and centralized control rather than the cumulative checks of many individual judgments. But so long as we prefer our present system, we should not get the jitters every time we feel the jerk of the controls.

THAT is what is happening now. Those costs *have* been catching up. The heavy buying of the last year, stimulated by accumulated shortages and low prices, has caught up for the moment with a demand, weakened by rising costs. Security prices that were discounting higher volume and profits have reacted into line with realities. Expansion programs geared to the initial surge of recovery are being adjusted to the long-term prospects.

But what of it? Every business man knows that last Spring he was worried about rising prices and orders beyond capacity. It felt good but he was afraid of it. Now the brakes have come into action and we have slowed down to a safer speed. That is what *didn't* happen in 1928 and 1929. So why the jitters?

These facts remain: we still are in a major recovery cycle and we are not spiraling crazily skyward as so many feared last Spring we might do; we still must go far before some of the basic industries resume their normal paces; technology continues the creation of new products and new efficiencies; merchandising continues to tell the world of the new goods and services available to gratify its increased productivity.

THESE are the long term realities, the ground-swell beneath the surface waves kicked up by political and corrective cross-currents. Already, qualified economic advisers are warning purchasing agents to think beyond their present hand-to-mouth policy toward one of future commitments; already they are suggesting to those who have suspended expansion programs that they consider reviving them before the next wave of rising costs. For soon we shall resume afresh the march of recovery.

This pattern of the general trend is pretty well determined; little can be done about it. But it need not apply to the individual business. The trend is but an average; necessarily some must be above this average. And it is those who will come best through the present breather and reap the first fruits of resumed progress. They will trim sail where they must, to conserve their earnings. But, mindful of the ground-swell, they will not relax an ounce of pressure in two vital quarters. To come out ahead of the field, they know that they must "put their plants on the most efficient possible basis and strengthen their sales and advertising effort for the months ahead."

True in January, that still is true today.

Willard Chevalier

ENGINEERING NEWS-RECORD

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Ten-ol is a new, fused lubricant developed especially for "Caterpillar" Diesels by the Sinclair Refining Company. Ten-ol prolongs engine life and cuts operating costs. It gives ten times more Diesel service hours than the finest straight mineral oil.

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· ENGINEERING NEWS-RECORD ·

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VOL. 119 *OCTOBER 14, 1937* No. 16

THIS WEEK AND NEXT

ONE of the remarkable rigid frame bridges of the year was opened to vehicle and street car traffic in Cincinnati this summer. Monumental in appearance by virtue of concrete pylons, hinge enclosure and railing, the McMillan St. bridge is distinctive in its three-span arrangement, with cantilever side spans, and its use of Vierendeel girder cross-frames.

For over a decade, H. J. Gilkey, first at the University of Colorado and then at Iowa State College, has been conducting tests of concrete subjected to various curing procedures and test conditions. Out of the vast amount of data from these tests, Prof. Gilkey has been able to fashion a set of conclusions that are of vital importance to every concrete user. His article "The Moist Curing of Concrete" establishes proper curing and test conditions on a par with the water-cement ratio as a criterion of strength.

The superiority of an arch dam over a gravity section for Ruby Dam is shown by a comparison of designs for each adapted to the site.

Foundation exploration for the high rock-fill dams proposed for the Passamaquoddy tidal power project developed new technique that will be helpful for all who have to conduct such work in deep water.

The economic loss resulting from impaired quality of public water supplies was analyzed by A. L. Shaw and E. S. Case at the New England Water Works Association Convention. See page 641 for an abstract of this paper.

NAVIGATION REQUIREMENTS have fixed the location of the Chickamauga Dam within a section where bad rock foundation conditions prevail. The first of a series of articles dealing with these conditions is scheduled for next week.

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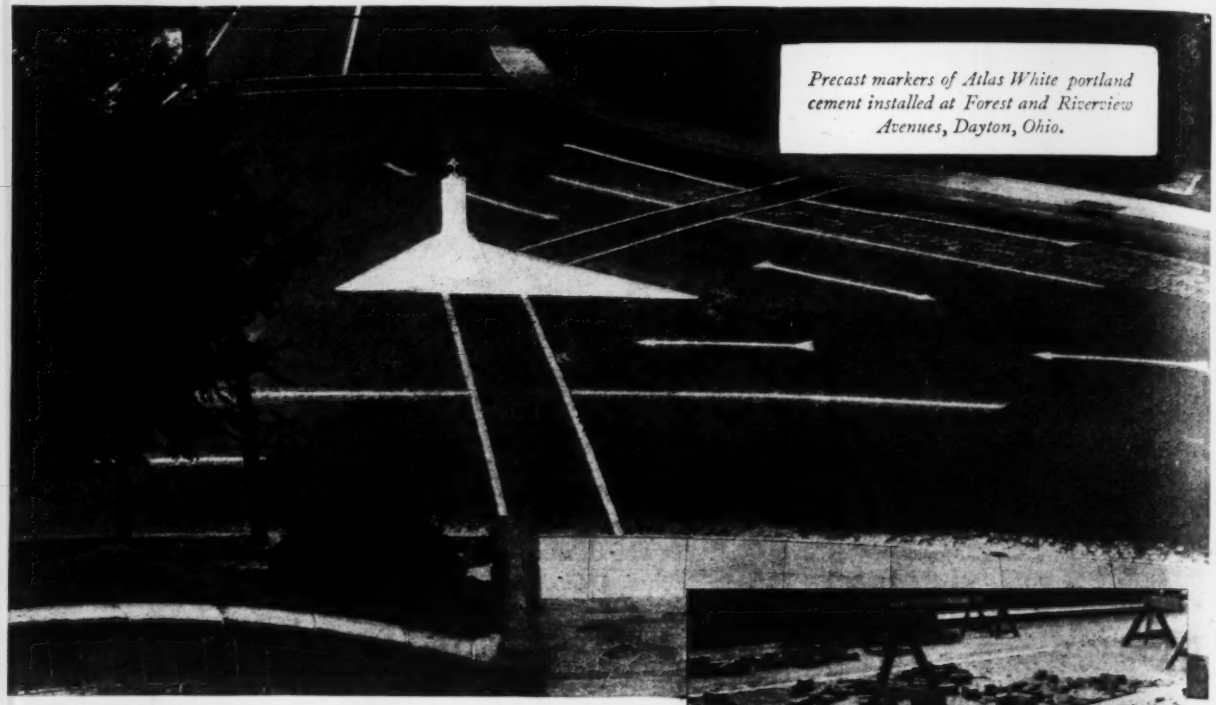
COVER PICTURE—Concrete box-girder highway bridge of 190-ft. central span recently completed in Pierce County, Washington. An early issue of Engineering News-Record will contain further information on this structure.

Number of copies of this issue printed 29,381

These permanent white markers will

NEVER HAVE TO BE REPLACED



Precast markers of Atlas White portland cement installed at Forest and Riverview Avenues, Dayton, Ohio.

THERE'S only one type of traffic marker that stays white permanently—the marker made of white portland cement and white aggregate.

It not only stays white without maintenance—it never requires replacement because it lasts as long as the pavement lasts.

Moreover, these markers actually *pay for themselves* over a period of years. And then they *continue* to save each year the cost of all maintenance otherwise needed.

Being *built* white, with a smooth, dense, hard white surface, they resist staining, and each rain washes them clean of surface dirt.

In winter months, installation of Atlas White markers (and curbs) can go right ahead. Precast sections are quickly and easily placed even in zero weather. Made indoors, they are simply moved to the job and set in place. Universal Atlas Cement Co. (United States Steel Corporation Subsidiary), 208 South LaSalle Street, Chicago.

EASILY, QUICKLY INSTALLED

(ABOVE) Precast arrows of Atlas White portland cement were installed in existing brick pavement.

•

(RIGHT) On the same job, precast markers of Atlas White portland cement were set in existing asphalt pavement.

M-16

ATLAS WHITE PORTLAND CEMENT

FOR TRAFFIC MARKERS

THE WEEK'S EVENTS

Power Company Plans Big Project

Pacific Gas & Electric Co. asks license for 6-dam project on Feather River

The Federal Power Commission will hold hearings Nov. 15 on an application by the Pacific Gas & Electric Co. of San Francisco for a permit to construct six hydro-electric power plants on the north fork of the Feather River in the counties of Butte and Plumas, Calif., which will have a total installed capacity of 358,000 kw.

Pacific Gas & Electric now owns and operates the only three hydro-electric plants on the north fork of the Feather River. These are the Big Bend, Bucks Creek, and Caribou plants. The six proposed plants would be built between the Caribou plant and the Big Bend plant, between which there is a difference in elevation of 2,072 ft.

The power to be developed in the proposed plants will be sold to consumers in the central and northern parts of California, and the projects will be connected to the company's present generating and transmission system. At present the company operates 39 hydro-electric plants with an installed capacity of 1,011,000 hp. and 18 steam plants with 427,000 hp.

Six plants planned

The Howells plant would consist of a dam about 145 ft. high, a tunnel about 25,000 ft. long and a 61,000-kw. power house operating under a head of about 650 ft. Two miles downstream from the Howells plant would be the Camp Rodgers plant which would include a 105-ft. high dam, an 18,000-ft. tunnel, and a power house operating under 295 ft. head and generating 59,000 kw.

The Rock Creek plant would consist of a dam about a quarter of a mile downstream from the mouth of Chambers Creek, about 55 ft. high, which would be connected through a 25,000-ft. tunnel to a 72,000-kw. power house near the mouth of Rock Creek, operating under a head of about 370 ft.

Downstream from the mouth of Grizzly Creek would be the 125 ft. dam of the Cresca plant which would also include a 17,000-ft. tunnel and a 64,000-kw. plant operating under a head of about 290 ft.

(*Continued on page 622*)

• • •

Riggs Is Nominated To Head A.S.C.E.

Henry Earle Riggs, honorary professor of civil engineering at the University of Michigan, has been selected by the board of direction of the American Society of Civil Engineers as official nominee for president of the society for the year 1938. This action was taken at the fall meeting of the society held in Boston, Oct. 6-9. Nomination is tantamount to election. Prof. Riggs retired from active teaching work in 1930 and is now practicing as a consulting engineer, specializing in valuation and rate cases.

HENRY EARLE RIGGS

Other action by the board included a decision to assign members of the society to local sections rather than leave affiliation to voluntary action as at present. Details of how the assignment is to be arranged are yet to be worked out.

A report of the meeting, in which the society was joined by the Engineering Institute of Canada, will be published in the issue of Oct. 21.

Ross Is Appointed To Bonneville

Seattle public power leader will administer transmission and sale of Bonneville power

Appointment of James G. Ross as administrator of the Bonneville project was announced Oct. 10. It had been believed for some time that he was in line for the appointment to this position. Mr. Ross is a member of the Securities and Exchange Commission and is also superintendent of the Seattle municipal light department. He has been connected with the Seattle system for 35 years, with the exception of a short period when he served as a member of the New York State Power Authority. In 1935 he was made chief engineer of the power division of PWA, and he was appointed to the SEC in 1936.

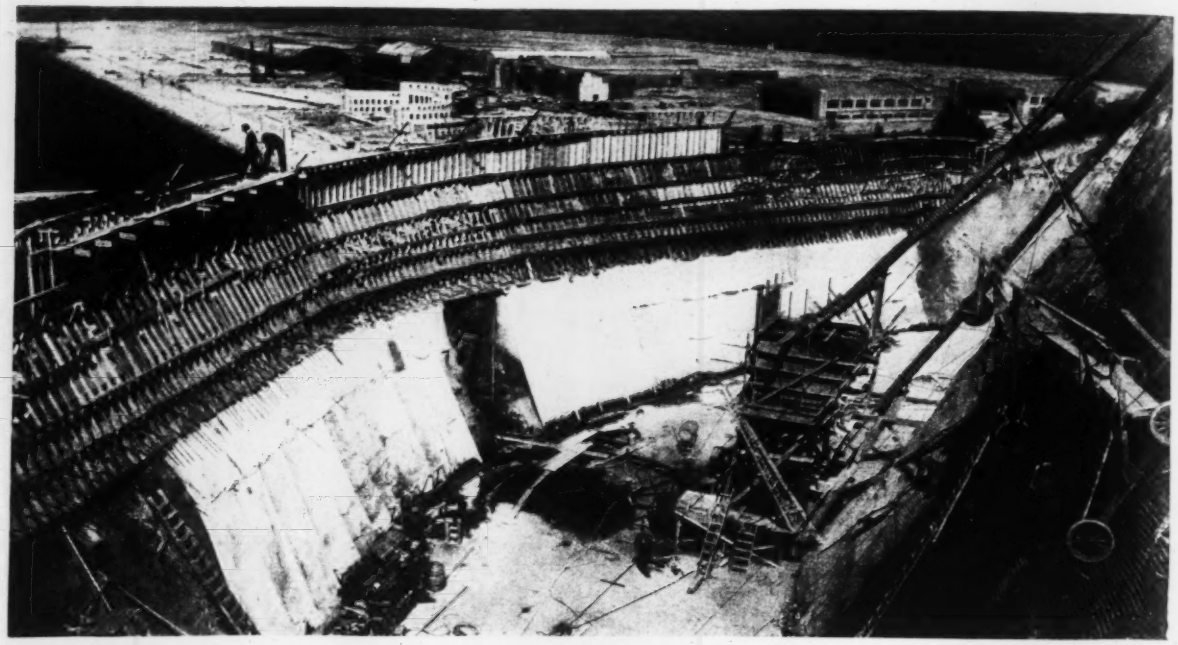
Will market power

As administrator of the Bonneville project, Mr. Ross will have the duty of administering the transmission and marketing of the power generated at the dam and will also establish rate schedules for the power, subject to the approval of the Federal Power Commission.

Generation started

Some of the power which Mr. Ross will have to dispose of began to be generated a few days before his appointment, when the President, on a visit to the project Sept. 28, set the first 5,000 kw. generator in operation at the plant.

The unit has already picked up all the loads required by the Army Engineers at the project site; this includes lighting and power for the operators' village, the power house load, and some of the construction load for the locks. Construction load for the other contracts in progress is still being carried by the Northwestern Electric Co., which previously served the entire project. The load now being carried amounts to from 600 to 800 kw.; the generator is kept running under a 27 ft. head, which is about two-fifths of the full head available on the generator.



WATER FOR TREASURE ISLAND

CONSTRUCTION of the 3,000,000-gal. balancing reservoir for the water supply of the 1939 Golden Gate International Exposition on Treasure Island in the San Francisco Bay has involved the excavation of about 25,000 cu. yd. of rock. The reservoir, on Yerba Buena Island, was trued up with shotcrete deposited in a thickness up to 18 in.

It is expected that about 1,800,000 gal. of water will be required every day for the exposition. The water will be piped from San Francisco to the Yerba Buena reservoir by way of the San Francisco Bridge.

In applying the shotcrete lining, army engineers rigged up a platform mounted on a wooden frame employing secondhand automobile wheels. The platform was operated from a block at the top of the bank 60 ft. above.

The man-made island, Treasure Island, on which the exposition will be held, can be seen in the background.

West Side Highway Opened In New York City

Although not yet entirely completed, the $24,340,000 West Side development in Manhattan, New York City, was opened to the public Oct. 12. Opening of the project provides an express highway from 72nd St. north to Dyckman St. and also opens a new waterfront park along the entire length of the parkway.

Construction of the 6.7-mile parkway involved filling in 132 acres of land along the riverfront and covering over the four-track freight line of the New York Central for a distance of 2½ miles. At certain points the highway itself runs over the track but throughout most of the length the parkway runs at the outer edge of the filled land next to the river and the area obtained by covering over the track is devoted to park use.

The new parkway connects the elevated highway in lower Manhattan with the Henry Hudson Parkway and bridge in upper Manhattan and the Bronx.

The parkway consists of two 34-ft. separated roadways with a concrete wearing surface. The maximum grade is 4 per cent, with a 2000-ft. minimum radius of curvature on the main highway and a 500-ft. minimum vertical sight distance.

Of the $24,340,000 cost of the project, $19,600,000 was appropriated by the city of New York, the railroad contributed about $3,200,000, and $1,540,000 came from federal aid grade crossing funds.

• • •

Sioux City Reservoir Fall Injures Three Workmen

Inadequate support for roof forms was blamed for a reservoir construction accident in Sioux City, Iowa, in which three workmen on the project were injured.

The three men were working in the pit of the eighth, and last to be poured, unit of the new reservoir while fresh concrete was being poured into wooden forms for the roof 20 ft. above their heads. The forms failed, dropping the concrete into the pit.

The rest of the roof was not endangered by the collapse of that part, and workmen immediately were put to work cleaning up the debris preparatory to reinforcing the roof again.

Pennsylvania Will Inspect Contractor's Water

The Pennsylvania Department of Highways has notified contractors that as a result of serious typhoid fever epidemics, last year and this year, which have developed on highway construction contracts, it will be necessary to exercise rigid control over the water supply used by highway contractors.

Under the new procedure, the highway department will notify the engineering bureau of the state health department whenever a contract has been awarded. The contractor will be required to notify the bureau of engineering of the health department of the location of the water supply which he intends to use; the health department will then examine the supply and notify the contractor and the safety engineer of the highway department as to whether the water supply is suitable. A contractor will not be allowed to start work until he has received a letter from the health department approving the water supply to be used for drinking purposes.

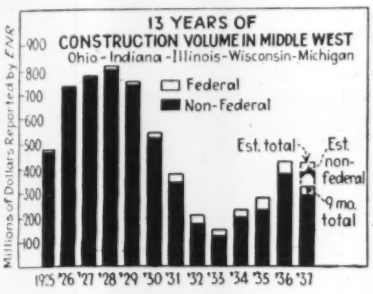
Highway department inspectors will check the water supplied for drinking purposes.

THE CURRENT TREND

This week's news of contract volume and construction cost factors

Middle West Leads U.S. In Sewage Disposal

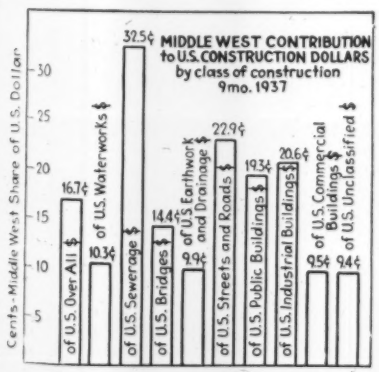
One-sixth of this year's engineering construction volume is in the Middle West, Ohio, Indiana, Illinois, Wisconsin and Michigan. The 9-months' total, $314,534,000, tops the same period last year by 6 per cent, and already exceeds the entire years of 1932 through 1935. Middle West construction as reported by *Engineering News-Record* reached its peak of $809,463,000 in 1928, and its depression low of $150,698,000 in 1933. Federal construction in this area reached its peak of $56,287,000 in 1935 when it made up 20 per cent of the territory's total volume. Prior to 1930 the federal volume ranged from

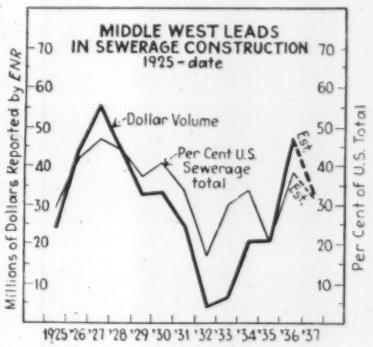


0.6 to 2 per cent of the total. This percentage jumped to 10 in 1931, and since its peak of 1935 has receded to 8 per cent as the current rate. This year's federal construction in the Middle West constitutes 15 per cent of the U. S. federal total.

This region averaged an expenditure of 34.4c. for every U. S. sewerage dollar spent in the past 13 years. The territory continues to lead in sewerage and waste disposal construction, contributing 32.5c. of each U. S. sewerage dollar expended in 1937.

During the first three-quarters of 1937, these five Middle Western states


MIDDLE WEST CONTRIBUTION
to U.S. CONSTRUCTION DOLLARS
by class of construction
9 mo. 1937
Cents - Middle West Share of U.S. Dollar
16.7¢ of U.S. Over All $
10.3¢ of U.S. Waterworks $
32.5¢ of U.S. Sewerage $
14.4¢ of U.S. Bridges $
9.9¢ of U.S. Earthwork and Drainage $
22.9¢ of U.S. Streets and Roads $
19.3¢ of U.S. Public Buildings $
20.6¢ of U.S. Industrial Buildings $
9.5¢ of U.S. Commercial Buildings $
9.4¢ of U.S. Unclassified $


MIDDLE WEST LEADS
IN SEWERAGE CONSTRUCTION
1925 - date
Dollar Volume
Per Cent U.S. Sewerage total
Est.
Millions of Dollars Reported by ENR
Per Cent of U.S. Total
'25 '26 '27 '28 '29 '30 '31 '32 '33 '34 '35 '36 '37

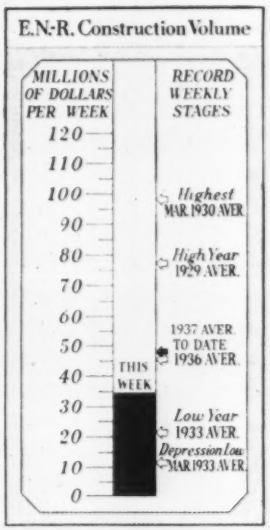
produced 10.3 per cent of waterworks construction, 32.5 per cent of sewerage and waste disposal, 14.4 per cent of bridge, 9.9 per cent of earthwork and drainage, 22.9 per cent of streets and roads, 19.3 per cent of public building, 20.6 per cent of industrial building, 9.5 per cent of commercial building, and 9.4 per cent of unclassified construction. Of public construction, 18.3 per cent, and of private construction, 14.8 per cent, comes from the Middle West this year.

Union vs. Non-Union Wages

Union wages in the building trades are compared with non-union rates in a report by the Bureau of Labor Statistics for 1936 for 23 selected trades of which 6 are reproduced in the accompanying table.

Of 186,145 employees covered by this study, 67.7 per cent are union and 32.3 per cent, non-union. Skilled workers make up 56.8 per cent, semi-skilled 23.0, and unskilled 20.2 per cent. The ratio roughly represents the proportion in which these degrees of skill were in evidence in the building operations scheduled in this survey.

Although the hourly rate for all workers in 1936 averaged 91.8 cents, wide variations exist in the different occupational groups. Highest rates reported were for hoisting engineers, with an average of $1.343 an hour. Ranking next were structural-iron workers, with an average of $1.332. The lowest average rate was 51.1 cents for sheet-metal workers' helpers.



ENR INDEX VALUES

Index Base	1913	1926
Construction Cost (Oct.)	244.55*	117.55
Construction Volume (Sept.)	148	65

* Correction of typographical error, Oct. 7 issue.

THIS WEEK'S FIGURES

(Thousands of Dollars)

CONTRACTS

	Week Ending Oct. 15 1936	Oct. 7 1937	Oct. 14 1937
Federal	$3,077	$4,048	$1,983
State & Municipal	13,028	19,393	15,077
Total public	$16,105	$23,441	$17,060
Total private	10,664	25,389	17,099
TOTALS	$26,769	$48,830	$34,159
Cumulative 1937 (41 weeks)			$1,968,997
Cumulative 1936 (42 weeks)			$1,869,832

Note: Minimum size projects included are: Waterworks and waterways projects, $15,000; other public works, $25,000; industrial buildings, $40,000; other buildings, $150,000.

NEW PRODUCTIVE CAPITAL

	Cumulative 1936 42 Wks.	1937 41 Wks.
NON-FEDERAL	$739,001	$1,303,653
State & mun. bonds	407,431	417,041
Corporate securities	204,359	478,547
PWA loans, grants	102,213	178,126
RFC loans	24,998	29,939
Fed. aid for highways	.....	200,000
FEDERAL	$691,237	$746,223
TOTAL CAPITAL	$1,430,238	$2,049,876

Regionally, the highest union average is in Middle Atlantic, $1.139, the lowest in West South Central, $0.919. The highest non-union average is in the Pacific states, $0.758, the lowest, in East South Central, $0.434. The highest combined average is in Middle Atlantic, $1.062 and the lowest in East South Central, $0.645.

Union Compared with Non-Union Wages by Bureau of Labor Statistics

Occupation	No. of Employees Total	Union	Non-union	Average wage per hour Both	Union	Non-union
All occupations	186,145	126,014	60,131	$0.918	$1.064	$0.612
Bricklayers	14,811	12,959	1,852	1.304	1.351	.972
Carpenters	33,040	23,258	9,782	1.048	1.150	.805
Engineers, hoisting (2 or more drums)	988	831	157	1.343	1.419	.942
Laborers, common	37,633	17,389	20,244	.516	.629	.420
Plasterers	6,800	5,797	1,003	1.292	1.354	.938
Structural-iron workers	4,806	3,717	1,089	1.132	1.396	1.111

Engineers' Union Has Membership Gain

CIO affiliation and membership drive bring number of members to 6,000

With 19 chapters and locals represented and an attendance of some 50 delegates, the third annual convention of the Federation of Architects, Engineers, Chemists and Technicians, held at Detroit Oct. 7 to 11, reported substantial gains in membership and in number of chapters. On Aug. 1, 1937, the federation affiliated with John L. Lewis' Committee for Industrial Organization, and part of the increase is due to this affiliation.

Working relations of the technical unions to the shop unions remain to be developed in detail. It is expected by the officers of the convention that some of the questions involved would be worked out at the C.I.O. convention in Atlantic City during the current week. It was indicated, however, that agreements between technical unions and employers, when not part of a general shop agreement, would be maintained without regard to questions or disputes arising in the shop. A standard form of agreement is being drafted.

Chapters represented by delegates included Boston, Providence (provisional), New York, Philadelphia, Newark, Westchester County (N. Y.), Washington, Syracuse (provisional), Rochester, Pittsburgh, Cleveland, Cincinnati, Dayton (provisional), Niagara Falls (provisional), Chicago, Moline, Ill. (provisional), Los Angeles, San Francisco (provisional).

It was announced that the Pittsburgh local of the International Federation of Technical Engineers', Architects' and Draftsmen's Unions, an A. F. of L. union, has voted by 90 per cent majority to affiliate with the F.A.E.C.T., adding more than 400 members. The Society of Designing Engineers (automobile body designers) negotiated for affiliation though it will remain a separate division. Total membership of the F.A.E.C.T., which was about 4,000 at the time of affiliation with the C.I.O. two months ago, was expected to reach 6,000 by the end of the convention.

A nationwide drive for organization of technical employees was announced; General Electric and Westinghouse are to be special objectives of concentrated organizing work. An appropriation of $15,000 has been made to organize one large Eastern concern (unnamed), in which drafting-room conditions were said to be specially bad and which is charged with maintaining a blacklist covering all industries of the state.

Discussion on the floor of the convention dealt among other things with difficulty in holding WPA members when they get private jobs, effectiveness of organization in discussions with employers, relations with civil service, and relations with technical and professional societies. Reporting on the latter subject, Marcel Scherer, national organizer, deplored the existence of hostility to the C.I.O. among technical men, and denied the charge of coercion to force technical men into unions. As to the attitude of the societies, he asked, "Will the technical societies line up on the side of Girdler and Ford, or on the side of the progressive elements, including our Number 1 Red, our President, Franklin D. Roosevelt?"

The difficulty in holding WPA members when they get private jobs was emphasized by speakers from several different cities. L. A. Berne, vice-president and Mid-West organizer, declared it to be definitely serious.

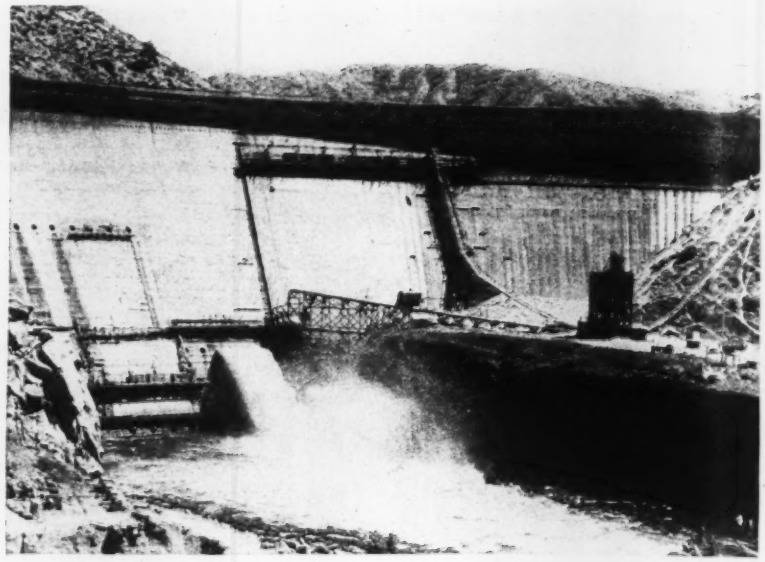
Milton Fischer, Washington, D. C., reported that civil service men shy back from an organization whose constitution sanctions strikes and picketing, and concluded that the organization must modify its tactics to allow for these views. A special committee was set up to develop a program applicable to all civil service.

Visscher Boyd, West Coast organizer, reporting on Coast conditions, described Los Angeles as a "whited sepulcher", advertised as an open-shop town free from labor-union control; he cited the case of an aircraft plant built on tax-free city land, and other free-land invitations to industry. However, organization of technical workers is progressing well, in some cases in direct connection with the industrial unions in the shop.

Replying to statements reputed to have been made by officers of the National Society of Professional Engineers denouncing coercion of technical workers by the F.A.E.C.T., the federation passed a resolution condemning such attacks as irresponsible and unsubstantiated and appealing to the rank and file of the N.S.P.E. "to repudiate the stand taken by the employer leadership of that organization toward the only organization actively engaged in advancement of the economic status of the employee professional engineer".

Auxiliary features of the convention were an exhibit on housing, city planning and industrial diseases, and addresses by Frank Lloyd Wright, Coleman Woodbury, W. N. Polakov and others.

New officers were elected as follows: Lewis Allan Berne, president; Robert M. Sentman, executive vice-president; James A. Gaynor, secretary-treasurer; Marcel Scherer, organizational director.



FACE-LIFTING JOB FOR ARROWROCK DAM

THE WORK of refacing Arrowrock Dam, near Boise, Idaho, is now being carried out by the Bureau of Reclamation. Concrete deterioration on the face of the dam necessitated chipping off a layer and placing a new slab. In addition to refacing the dam, the height was raised 5 ft. Total cost of the work is about $600,000.

New slab has been placed on the dam from the right abutment to the center, as may be seen above. The weathered concrete with pins in place for the slab can be seen at the left.

Engineers Aroused By Union Issue

National professional society holds active discussion of drive to unionize engineers

Spirited discussion of the pros and cons of unionization of engineers marked the third annual meeting of the National Society of Professional Engineers held in New York, Oct. 8-9, and brought out a surprising amount of evidence of sympathy for the union movement and some active support of it among members of the society. Consideration of the subject was scheduled for Saturday morning but informal anteroom discussion began as soon as the members assembled on Friday, due chiefly to some unfortunate advance newspaper publicity to the effect that the society's officers feared that representatives of the Federation of Architects, Engineers, Chemists and Technicians, a C.I.O. union, would attempt to interfere with orderly discussion of the union question. As a result, interest in the union question served to divert attention from an unusually thoughtful presentation of comment on a group of other subjects on Friday afternoon.

Actually, little fireworks appeared at the Saturday morning meeting. At the opening of the session, Arthur Sheridan, president, declined to permit Harold Fink, a member of both the N.S.P.E. and the F.A.E.C.T. to have a stenotype operator take notes on the meeting for the federation, stating that copies of the society's minutes would be available to all who wanted them. Mr. Fink accepted the ruling and the operator withdrew. Later when the meeting was thrown open to discussion, he was among the first men to be recognized by the chair.

Discussion was opened by Raphael J. Smyth.

After reviewing legislation relating to labor, especially the Wagner Act, which he said has been taken by organized labor as implied authorization to unionize all employees, Mr. Smyth turned his attention to professional men, especially engineers, to point out that they stand in a peculiar position with regard to strikes—the chief tool of the trade union. An engineer, said Mr. Smyth, in accepting a license from the state, takes an implied oath to protect public life, health and property. He cannot, therefore, strike or support a strike under many circumstances without violating that oath. Mr. Smyth cited strikes on transport systems, on water supplies or power plants.

To correct this situation Mr. Smyth urged the amendment of the Wagner act to clarify the position of professional men.

Mr. Smyth expressed no opposition to labor unions and pointed to the good work they have done in improving working conditions generally. He did, however, express opposition to the unionization of engineers, especially the reputed coercion of engineers in industrial organizations where vertical unions have been organized. He said that the N.S.P.E. had no desire to enter into a conflict with any body that does not coerce its members.

Little coercion

In reply to a request from Mr. Sheridan for definite evidence of coercion, John Avery stated that in Westchester County (N. Y.), where the first charge of coercion had originated, it had been impossible to get the men who said they had been compelled to join a union to make definite charge of coercion.

J. B. Diamond, in defense of the A. F. of L., said that it does not require engineers or any other member holding key positions in governmental agencies to go on strike. Harold Fink, speaking for the C.I.O., said that it has made exemptions for men who might jeopardize life by striking. He said that all the charges of coercion that appeared in the advance publicity for the meeting were based on flimsy evidence.

M. H. Blez of Philadelphia also deprecated the charges of coercion and took exception to Mr. Smyth's statement that engineers violate an implied oath when they strike and asked whether the society is going to represent the views of employers or employees. He would not have the society put itself in the position of being opposed to organized labor lest organized labor retaliate by supporting legislation detrimental to the profession.

F. H. Dechant, president of the Pennsylvania state society, urged tolerance in consideration of the whole subject. The profession must work to improve its own standards, he said.

The society was criticized by Frank Lilien for not having done enough to help its members to better their economic position. There had been too much talk and too little action, he said, adding that men go into unions because they believe unions will do something for them.

D. B. Steinman took Mr. Lilien's challenge as the starting point for a plea to the society to do more for the engineer in training. The society, he said, must help these men solve their problems if it is to succeed in its objectives. It can improve the financial position of engineers by a dignified presentation of its claims for just compensation for engineering.

Dr. Steinman said engineers can join unions if they wish to but that it is highly undesirable for them to do so because joining a union causes confusion in the public mind as to whether engineering is a trade or a profession.

Commenting on the discussion, Mr. Smyth said that it was probably difficult to establish the fact that coercion had been exerted, first because it was difficult to define coercion, and second because the men coerced know they will get themselves into trouble by publicity supporting the charge. However, he pointed out that efforts to obtain a closed shop in themselves constitute coercion on men who do not wish to join the union.

Wagner Act amendment

At the close of the meeting a resolution was adopted calling for amendment of the National Labor Relations Acts to exempt all professional men from a requirement that a non-professional organization represent them in collective bargaining.

Other resolutions adopted called for establishment of a secretariat of public works in the national government; endorsed the 1937 revision in the model registration law; and urged the adoption of uniform requirements for education in state license laws. This latter resolution would have knowledge of "cultural and humanitarian subjects" included and would have engineering schools mold their instruction to meet these requirements.

The Friday afternoon session was given over to a discussion of national and state problems including the following: Legislation and registration, D. B. Steinman; the engineer in politices, Perry T. Ford; national problems for engineers, Harry T. Harris; and what engineering as a career has to offer to youth, John C. Riedel.

An interesting feature of the convention was exhibits by manufacturers and by the engineering departments of public agencies around New York.

Arthur V. Sheridan was re-elected president and Willard S. Conlon and Walter L. Simpson were re-elected secretary and treasurer, respectively. New vice-presidents are T. H. Dechant, C. E. Bardsley and Wm. Furber. The society will meet in Pittsburgh next year.

LABOR NOTES

ANSWERING charges made by the executive council of the A.F. of L. in its report to the Denver convention that the National Labor Relations Board had unduly favored the C.I.O. in its decisions, J. Warren Madden, chairman of the N.L.R.B., quoted to the convention the section of the Wagner Act making it unfair practice for an employer to interfere with, restrain, or coerce his employees in the right to self organization and collective bargaining and said, "The meaning of these provisions is plain beyond question. They do not say and they do not mean that it shall be an unfair labor practice for an employer to coerce his employees to join a union unless he coerces them to join an American Federation of Labor Union. They do not say and they do not mean that it shall be an unfair labor practice for an employer to coerce his employees to join a union unless he coerces them to join a Committee for Industrial Organization union. . . . With the division in the labor movement and with competition between the A.F. of L. and C.I.O. for the right to represent the workers in the same plant, the employer, not unnaturally, may have preference for one group. . . . The law forbids him to give effect to that preference by coercing his employees to join the preferred union or not to join the other union."

An N.L.R.B. decision calculated to reduce somewhat such criticisms as were made by the A.F. of L. ruled on Oct. 6 that a minority craft union may be a bargaining agent for workers in a plant where the majority of the employees are members of an industrial union. The board ordered an election among three craft groups among the employees of the Commonwealth Plant of the General Steel Castings Corp., Granite City, Ill. to determine whether these groups wished to be represented by an A.F. of L. union, a C.I.O. union, or neither. The Amalgamated Association of Iron, Steel and Tin Workers, representing, according to the board, 2,100 of the 2,700 employees in the plant, had claimed that the plant should be treated as a unit for collective bargaining purposes. The Pattern Makers Association, the International Brotherhood of Boiler Makers, Iron Shipbuilders, Welders and Helpers, and the International Association of Machinists, claimed jurisdiction over an aggregate of about 450 craft workers. In its decision, the board stated: "In view of the essential interrelations of the various departments of the plants, there can be little doubt that the board could find that the point claimed [by the C.I.O.] is a logical one. . . .

"The federation unions, however, have shown that there exist in the plant several groups which, in the absence of conflicting claims by other unions, could be found by the board to constitute separate units appropriate for the purpose of collective bargaining. . . .

". . . The men in the smaller groups should be given an opportunity to determine for themselves whether they desire to be represented separately or together with the balance of the plant."

Rejoinder was made to another A.F. of L. statement when John L. Lewis, chairman of the C.I.O. commenting on President Green's demand that the convention expel the C.I.O. unions from the A.F. of L. said, "Our attitude is one of complete indifference. Our understanding is that we have no association in fact with the A.F. of L. We are separate and apart. . . . No relation exists, so the passage in the resolutions in Denver using the word expulsion instead of suspension is a matter of complete indifference."

Speaking on the eve of the meeting of C.I.O. unions begun in Atlantic City October 11, Mr. Lewis said that wage increases of about $1,000,000,000 had been won by C.I.O. agreements. About $250,000,000 of this was in steel, $100,000,000 in auto, and $12,000,000 in transport.

A nine weeks' old plasterers' strike in San Francisco ended the first of the month in an agreement between the Master Plasterers Association and the Operative Plasterers and Cement Finishers International Association, Local 66. The agreement provided for an increase from a rate of $9 to a rate of $10 a day, a six-hour day, and arbitration of all disputes except working hours. The question of wages and all other matters except hours will be reopened next February for a new agreement which will be made effective May 1. In an unusual provision, the union obligates itself to establish a fund to reimburse contractors for the difference between new and old wage scales paid on contracts on which bids were made before April 23, 1937.

A shorter strike was ended in Jackson, Miss., when building work resumed after ten days during which skilled construction workers had been out in sympathy with the common laborers union. The strike is unofficially reported to have been terminated by

PUBLIC WORKS LEADERS

NEW OFFICERS of the American Public Works Association, elected at the annual meeting in Atlanta, October 4-6. They are, left to right: Guy Brown, St. Louis, first vice president; J. Eugene Root, Cincinnati, president; Roy L. Phillips, Meadville, Pa., treasurer; and John S. Lockhart, Newark, N. J., second vice president of the association.

an agreement to recognize the common laborers union, an A.F. of L. affiliate, and to raise common labor rates from 30 to 40 cents an hour on new projects, with the present rate obtaining on all projects now under way.

Common laborers also received support from the skilled trades in Youngstown, Ohio, where on Oct. 6 the Building Trades Council called union workmen off the South Side Hospital project and a project at St. Dominic's Roman Catholic Church in protest against hiring of non-union common laborers.

The strike called Aug. 14 by a C.I.O. union on the San Jacinto Tunnel of the Metropolitan Aqueduct is still going on, but the management of the Metropolitan Water District, who are building the tunnel, report that excavation is proceeding on a normal basis with a force of 996 workmen on the tunnel job. Of these, 790 have been put on since the strike. Since the strike was called, 798 ft. of the main tunnel have been excavated, water district officials said, bringing the total excavation to 9.3 miles of the 13-mile tunnel.

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Form of Unemployment Query Is Announced

The administrator of the unemployed census made public on Oct. 5 the form which will be used in the questionnaire which is to be distributed in taking the census of unemployment authorized by the last congress. In making the census, which is to be on a voluntary basis, the questionnaires will be distributed throughout the country by the Post Office, and the unemployed are expected to fill them out and return them voluntarily. The voluntary returns will be checked by house-to-house tabulations made in sample areas to determine the correlation between voluntary and house-to-house returns.

The questionnaire, an 8x9 in. card, will bear on one side a message from the President, pointing out to the unemployed the importance of an early and accurate return. On the reverse side will be 14 questions to be answered. They ask for name and address, whether totally or partly employed or engaged on work relief Projects, and whether the person is able to work. Age, color and sex are to be given, as are the number of hours worked in the past week and the number of weeks worked in the past year. The occupation and industry is asked for and the number of other workers in the family and their employment status. Finally, the number of dependents and the total income earned during the past week is also asked.

Sixty million copies of the questionnaire will be printed and will be sent to an estimated 31,000,000 families. Only the unemployed or partially unemployed are expected to return the cards.

Although press comment has been generally unfavorable to the plan for a voluntary census, those in charge of the census point out that an enumerative type of census would cost $20,000,000, would take about two years before results were available, and could not be handled by the Census Bureau, which is now busy preparing for the 1940 census. They point out also that there is a real incentive for the unemployed to answer. If a substantial portion fail to answer the public will get the impression that the number of employed is less than is the case, which would tend to mean a reduction in the amount of relief appropriations.

Returns, they say, can be checked readily for padding by means of the smaller control censuses which are to be taken, and if any substantial amount is revealed it also would create the impression that the load is less than is really the case, and this too would work against the interest of the unemployed.

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C. of C. to Stimulate Residential Building

The U. S. Chamber of Commerce has announced plans to call a building industry conference at an early date to analyze the causes of the slowing down of residential building and suggest means for stimulating activity in this field. It is expected that the conference will be held in the latter part of November or early in December at Washington.

In its announcement, the chamber stated that whereas an increase of 50 or 60 per cent in residential building had been expected in 1937 over the 275,000 units built during 1936, the rate of increase has so slackened in the last three months that "it now appears that the increase will scarcely be more than half of that predicted."

The decision to call the conference was reached after canvassing representatives of building materials dealers, contractors, and architects to determine in what way the chamber could be helpful in stimulating residential building. It is intended that the conference will develop practical ideas and suggestions which local chambers of commerce can put to work in their respective communities.

Public Works Men Meet in Atlanta

Administrative, personnel, and operating problems are stressed at A.P.W.A. Conference

Municipal engineers and officials focused attention on public works personnel problems, paving research, and city works design and construction at the 43d annual meeting of the American Public Works Association in Atlanta Oct. 4-6. Among the 200 delegates were representatives from 22 states and two Canadian provinces.

Veteran awards, given each year to those members of the organization who have been in the continuous employ of a municipality for more than 25 years, were conferred upon: A. F. Theard, New Orleans; B. F. Snyder, E. J. Dauner, and Thomas Buckley, all of Philadelphia; and John B. Stewart, Renfrew, Ont., Canada. A special award was presented to Edward S. Rankin, division engineer, Newark, N. J., who has served his city for 50 years. Mr. Rankin, the oldest member of the A.P.W.A., received the regular veteran's award when it was first established in 1930.

J. Eugene Root, director of public works of Cincinnati, was elected president of the association to succeed Thomas Buckley of Philadelphia. Other new officers chosen were: Guy Brown, St. Louis, and John S. Flockhart, Newark, vice-presidents; Roy L. Phillips, Meadville, Pa., treasurer.

After a round-table discussion on means to improve public works personnel, a resolution was unanimously adopted endorsing the merit system of personnel administration in government service. It was declared that present ideas and operation of the so-called "civil service" method needed overhauling to eliminate long recognized weaknesses. The merit system, with its well defined policies of selection, promotion and retirement, was held to be the best means for attracting and holding good men in public service.

Practices in pavement construction in which the engineer is forced to use rule-of-thumb procedure because of the absence of scientifically established facts were scrutinized in a symposium on needed research in street paving. Although the design and construction of efficient road surfaces —concrete, brick, and bituminous— have made steady progress, much work remains to be done. Also touched upon were the development of methods for treating and stabilizing subgrades, stabilization of road surfaces them-

(*Continued on page 622*)

Public Health Men Discuss Sewage

Join with the Federation of Sewage Works Associations in session at New York meeting

Industrial wastes received a good share of the attention in the program of the joint meeting of the Federation of Sewage Works Associations and the American Public Health Association in connection with the latter's convention in New York Oct. 5-8.

Almon L. Fales, of Metcalf & Eddy, Boston, presented a paper on the effect of industrial wastes on sewage treatment, and Dr. Willem Rudolfs, chief of the New Jersey Sewage Experiment Station at New Brunswick, gave extracts from his survey of recent developments in the treatment of industrial wastes. Charles C. Agar, New York state senior sanitary engineer, gave some practical methods for preventing dairy waste nuisance. The value of sewage sludge as a fertilizer was covered quite thoroughly by a report of the committee on sewage disposal. Parts of this report were read and commented upon by the committee chairman, Langdon Pearse, sanitary engineer, Sanitary District of Chicago.

Mr. Fales stated that all types of wastes are now going into the sewerage systems of most cities and that, in view of this fact, there is need for a better understanding of the nature of these wastes. He pointed out various types of industrial sewage that should not go immediately through the regular channels, stating that some should be excluded and some pre-treated.

"In view of the need of controlling the admission of industrial wastes to sewerage systems," Mr. Fales said, "it is important that suitable laws or ordinances be in force. . . . Such laws and ordinances should provide for periodic examination of industrial wastes discharged at the different industries, and supervision of operation of any pre-treatment works required, not including recovery processes which the industries may find it advantageous to adopt. Municipalities should cooperate with industries to the fullest extent practicable. However, access to the sewers should be denied existing or new industries which fail to comply with the requirements."

Mr. Fales gave Milwaukee as an example of a city having such control. Requirements there are based on industrial waste surveys.

Dr. Willem Rudolfs' paper on recent developments in industrial waste treatment covered treatment of the following: gas and phenol; dairies; brewery, distillery, and fermentation; tannery wastes, meat packing and canneries; sugar wastes; oils, grease and laundries; textile, dye, paper, alcohol; mine wastes; pickling liquors. It is Dr. Rudolfs' belief that the effect of trade wastes on the pollution of streams varies considerably, but he says that recent surveys have shown that it might be material and sometimes as much or more important than the discharge of domestic sewage. He said that many sewage treatment plants in this country and abroad are handicapped by various industrial wastes.

In commenting briefly on future trends, Dr. Rudolfs stated that development appears to be in so many directions that it would be difficult to show definite trends, except that there is a tendency to take care of the waste in sewage treatment plants wherever possible, and that treatment of trade wastes alone appears to become more and more complicated.

A report, read in part by Langdon Pearse, concluded that sewage sludge is of use as a fertilizer if properly prepared and applied. Its value varies with the type. Conclusions regarding the types of sludge are as follows: Fresh sludge is seldom used and may be troublesome, because of grease content, odors and bacteria present; digested sludge, whether wet, air-dried or heat-dried, appears to have use as a substitute for manure and is of about the same fertilizing value; activated sludge, heat-dried, appears to have real value as a source of organic nitrogen fertilizer.

The report recommends that an effort be made by sewage works operators to popularize the use of sludge by users of fertilizer. Further studies should be made of the use of sludge as fertilizer by such agencies as agricultural experiment stations.

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Power Company Plans Big Project

(*Continued from page 615*)

The Pulga plant would consist of a dam a short distance upstream from the present Big Bar stream-gaging station. The dam would be about 35 ft. high and would connect through a 14,000-ft. tunnel with a 62,000-kw. power house operating under a head of about 270 ft.

The sixth development would be the Poe plant, consisting of a dam about ½ mile downstream from the Poe Siding about 180 ft. high, a tunnel about 3,000 ft. long and a 50,000-kw. power house located at the upper end of the diversion reservoir of the present Big Bend plant and operating under a head of about 197 ft.

Three More Injunctions Against P W A Power

The U. S. District Court for the District of Columbia on Oct. 7 issued preliminary injunctions preventing the disbursement of PWA funds for the construction of three municipal power projects. The orders are expected to remain in force until the U. S. Supreme Court decides two pending test cases on the constitutionality of PWA power loans brought by the Alabama Power Co.

The three cities concerned, and the utility companies bringing the suits, are: Columbus, Nebraska—Northwestern Public Service Company; Ashland, Wisconsin—Lake Superior District Power Company; Thayer, Missouri—Arkansas-Missouri Power Company.

By agreement between counsel one of the pending Supreme Court cases challenging the constitutionality of PWA power allotments has been dropped, leaving still on the calendar for review the two cases brought by the Alabama Power Co., with the probable addition of a third brought by the Duke Power Co. and decided by the U. S. Court of Appeals Sept. 2.

The case that has been dropped was brought by the Iowa City Light and Power Co. protesting a proposed PWA grant of $413,000 to Iowa City. The municipality has now abandoned its plan to construct a power plant, so the Supreme Court on Oct. 5 dismissed the suit.

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Public Works Men Meet in Atlanta

(*Continued from page 621*)

selves, and the use of new road mixtures.

Public works in Atlanta were highlighted in two papers. One dealt with the $7,000,000 sewage disposal program now almost completed. Sewer extension totaling 78 miles and construction of five treatment plants have been undertaken. Operating experiences at the Atlanta Refuse Incinerator, where steam is generated and sold to local utilities, were also described. Steam sales from the incinerator plant for the period from 1925 to that of 1928 have netted the city more than $255,000.

Other papers presented at the meeting dealt with establishment of rate charges for municipally owned utilities, planning in small cities, refuse collection problems, and the Birmingham industrial water supply.

A complete technical report of the meeting will be published in next week's issue.

COMMENT AND DISCUSSION

Readers' opinions on matters that concern the engineer

Fishways at Bonneville

Sir: I note in your Sept. 23 issue, p. 526, a news item referring to tests made by H. B. Holmes by passing fingerling chinook salmon through the penstock and turbines of the Cazadero plant of the Portland General Electric Co. on the Clackamas River near Portland, Oregon. You also have editorial comment on p. 498 of the same issue relating this test to the Bonneville project.

While I wish to express a feeling of full sympathy for the problems of an editor in passing competent comment on current topics, I am afraid that your editorial paragraph is based on a misinterpretation and may cause further confusion.

I was associated with Dr. Holmes and Milo C. Bell, engineer of the Washington Bureau of Fisheries, in preparation and development of fish-lock designs and methods for passing salmon through the Bonneville Dam, and am familiar with the problem as worked out on that project. There appears to be no connection whatever between the Cazadero tests and the situation existing at Bonneville.

The Francis turbines at Cazadero are of the horizontal type fed by a steel penstock and rotating at 360 r.p.m. The blade spacing in these wheels is typically close so that *the individual openings* presented for the passage of fish or debris *are very small, probably less* than *one and one-half feet by one-half foot* normal to the flow of water. In addition, the flow path is curved.

On the contrary the propeller turbines at Bonneville will present openings normal to the blade surfaces, approximately 5x8 ft., or something like fifty times as large. The projected opening areas normal to the axially flowing stream will be even larger. In addition, the Bonneville turbines will rotate at a speed of 75 r.p.m. or one-fifth as fast as the wheels at Cazadero.

The comparative loss of fingerling salmon may be roughly expressed as the compound factor or 1/250 of the 50 per cent figure stated by you at Cazadero.

Surely a 1/5 of 1 per cent anticipated loss does not justify the expression of alarm in your editorial comment.

This conclusion may be further substantiated by the results of tests made three years ago on the approximately 15 ft. diameter propeller turbine of a power plant on the Clearwater River in Idaho, which showed that only minor damage was to be expected.

I understand that the Cazadero tests were for an entirely different purpose than that of checking on the performance of the Bonneville turbines and hope that you will endeavor to correct the unfortunate impression created by your editorial so that the controversy which clusters around the complex Bonneville fishway problem may, to that extent at least, be cleared.

Washington, D. C. H. G. GERDES
October 1, 1937

Neatest Trick of the Week

Sir: The following, quoted from p. 439 of the Sept. 9 issue of Engineering News-Record, sure is a neat trick—if you can do it:

"As an experiment two sections, each 250 ft. long, were prepared instead of a 500 ft. section. Each 250-ft. section was completed before the other was begun."

Ontario, Calif. JOHN MARINER
September 28, 1937

Land Descriptions

Sir: The writer read with interest and appreciation, "Drafting Land Descriptions" by Archer W. Bedell in the September 30, 1937, issue.

Too little attention has been paid to drafting accurate and brief land descriptions. It is gratifying, therefore, to read an article which covers the ground so well. There is one point, however, which Mr. Bedell does not touch upon, and that is the lawyer's viewpoint of land descriptions.

I agree that a description in words and figures is confusing. Still, in Illinois at least, if a land description in a deed is to be approved by a lawyer, the latter will insist that the same be in words and figures, and makes the point that "this is for greater accuracy" although as a matter of fact, it makes for greater inaccuracy because it affords two opportunities to make a mistake instead of one.

Mr. Bedell's comment on simplifying metes and bounds descriptions (which an old surveyor the writer once knew always spoke of as "leaps and bounds descriptions"), is excellent, as the writer knows by his own experience in attempting to retrace in the field ancient descriptions of this kind. He recalls one which began as follows: "Commencing at an overcup oak wherein a dove sat singing." The remainder of the description was on a par with the beginning.

Beardstown, Ill. ALLAN D. MILLARD
October 4, 1937

Pay of Engineers

Sir: Up pops Odd Albert (Sept. 14 issue) and out comes a squawk; not the scientific reasoning of an engineer from cause to effect, but the philosophical deduction of a sophist. He stops just short of saying: all engineers who receive pay less than what is necessary for the average engineer's family to live on should be taken out and shot.

He can see that the less the least-paid engineers receive, the less will all receive, but he does not seem to be able to see that the more the least paid receive, the more all employee engineers will receive. If he sees it he keeps still about it; he has the employer's viewpoint.

He, like a number of engineers, now thinks it's slick to talk like lawyers. They would even make the N.S.P.E. like the Bar Association.

Pittsburgh, Pa. EVEN BENJAMIN
October 5, 1937

Correction

Sir: In the article on "Curve Computation Shortcuts" (ENR, August 26, p. 362), the chord correction for 50-foot arcs should have been:

$$\left(\frac{\text{Degree of curve}}{8}\right)^2$$

as shown on original draft and corrected proof.

Babylon, New York W. B. HOGAN
September 8, 1937

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OCTOBER 14, 1937

PUBLIC CONSTRUCTION of projects that have no present economic justification without revealing that fact to Congress and to the public was strongly condemned at the meeting of the American Society of Civil Engineers held in Boston last week. Similarly, failure to make public the total *ultimate* cost of great undertakings like the Grand Coulee power and irrigation project was severely criticised. Bonneville, Fort Peck, Grand Coulee, Passamaquoddy, and the Florida Ship Canal all were made the subject of adverse critical comment. It was pointed out that in almost every instance reports unfavorable to the projects that were made by the army engineers or by special boards were kept in the background or were never made public.

Intangible Benefits

IN THUS CONDEMNING the inauguration of great public works without adequate study and full revelation of the probable dollar return upon the necessary investment the American Society of Civil Engineers is on sound ground. But when it sets out to extend its condemnation to cover all projects for which no direct and reasonable return on the investment can be shown, as some of its members would have it do, it is skating on thin ice. If all public work is put on a dollar-and-cents return basis we would build few parks and no playgrounds, no monumental buildings and few of our arterial relief highways. Further, as both Wm. J. Wilgus and F. H. McDonald pointed out, not a few projects that were considered visionary when they were started turned out to be of great value because of the regional development that they stimulated. In an emergency such as that of recent memory the nation cannot weigh expenditure against expected return. If a project provides satisfactory work for a large number of people and indirect employment for many more in production and transportation of materials, then the matter of return on the investment becomes of secondary importance. However, projects for which there is no immediate economic justification should not be undertaken when an equal amount of useful work can be provided on more immediately desirable projects; nor should they be undertaken to obtain by indirect means an objective that cannot be obtained openly or to satisfy the importunities of interested promoters. It is on these latter scores that some of the great federal projects of today can be most justly condemned.

At Your Service

THE LEGAL, engineering and medical aspects of occupational diseases are becoming so complex and are changing so fast that industry finds it difficult to keep track of them. This is especially true of silicosis, the only major occupational disease that concerns construction. We find that the construction industry is woefully ignorant as to what is going on in silicosis control and legislation. How may it become enlightened? By taking advantage of the services offered by the Air Hygiene Foundation, of Pittsburgh, a non-profit institution supported solely by industry membership. In the brief eighteen months of its existence the foundation has cooperated with every major movement to alleviate occupational disease where caused by dust, gas or fumes, and has prepared engineering, medical and legal reports on silicosis, the last including a digest of all state laws and insurance regulations pertaining to the disease. It is now engaged in a research program to determine the correct design for exhaust hoods for drill dust control and a study of dustiness created by rock drilling and blasting. Contractors with rock drill dust problems will find the Air Hygiene Foundation at their service. They need the foundation and the institution deserves their support.

Concrete Curing

PROPER CURING is as fundamental to good concrete construction as is the choice of the right water-cement ratio. This fact, established qualitatively by many investigators, is given a quantitative basis by results of an extensive series of tests at Iowa State College which climaxed over a decade of research and study on curing carried out by Prof. H. J. Gilkey, who presents his data in this issue. The results have not yet been reduced to design recommendations but it is important to note that specimens tested dry are about 30 per cent stronger than wet-tested specimens. This is an advantage on the side of safety, since design strengths are usually based on wet-test values. On the other hand, the results indicate that saturation of a dry specimen quickly reduces its strength by as much as 20 per cent. Unless the specimen has had at least 20 days of moist curing prior to air exposure, such saturation at the age of a year can reduce the strength to below the 28-day design value. This would be more disquieting were it not for the fact that the saturation causes a resumption of curing and therefore a strength increase. Nevertheless

it is a significant finding which emphasizes the necessity for a considerable period of moist curing. Evaluation of all the test results in terms of their significance to concrete designers and users is a job requiring wide collaboration. It is hoped that their publication will foster that undertaking.

Elevated Highways

THE COMPETITION recently announced by the A.I.S.C. to produce designs of attractive and workable elevated highways lays emphasis upon two of the most unsatisfactory conditions that still confront city traffic engineers. These conditions are (1) that the motor vehicle of today moves across congested districts no faster than the horse-drawn vehicle of two decades ago and (2) that pedestrians are involved in a majority of city traffic accidents. The elevated highway does much to solve the problems incident to these conditions. But it also has disadvantages, both real and imaginary. And it must compete with other possible solutions. A worthy design problem is thus set by the competition.

Given an existing street—for the competition properly rules out as a special condition the acquisition of new right-of-way midway between blocks—what are the possible solutions to the problem of more speed and safety for urban traffic? There are three. First, depress the high-speed lanes below the local surface traffic and the sidewalks. Second, fence off the high speed lanes and leave them at the surface. Third, build an elevated highway. The first two require grade separations at the cross streets; the elevated highway is itself a continuous grade separation. The first and third require access and egress structures, the second can utilize inexpensive turnouts. All are equal so far as the safety of the pedestrian is concerned; he is isolated from the high-speed traffic but is still subjected to local traffic hazards.

And all are equal in another important respect: each requires a wide street for its location. The elevated highway, it is true, provides extra traffic capacity over the depressed or the surface limited-way, since the area beneath it can be used for trucking or parking. But unless the elevated is located on a wide street it will destroy property values at street level that will completely offset the traffic savings that it provides. One therefore must accord an elevated highway a street wide enough to allow a surface traffic lane or two on either side.

Finally there are several specific requirements that the elevated highway must meet. Among these are attractive appearance—for the elevated railway has created a psychological obstacle that must be overcome. While the highway would seem to improve upon the railway on the score of noise, designers nevertheless should seek the best combination of roadway surface and tires to eliminate "singing". Economical span length and framing layouts are another requirement. Safe railings are a prime demand. Proper spacing and design of off-and-on ramps present another problem. And, as important as anything is fixing a proper ratio of elevated highway width to street width.

Bypasses do not solve the city traffic problem. Some other expedient is urgently needed. If it is the elevated highway, only New York among our cities can claim to have had any experience with that type of artery. And its West Side Elevated Highway along the Hudson River waterfront, although highly successful and the scene this week of a celebration opening a new northern extension, is in reality a marginal way and so does not test the ultimate possibilities of elevated highways as a means of relieving traffic congestion. The design competition, therefore, is concerned with a wholly new expedient. If it succeeds in stimulating widespread and careful thinking on the problem of the future of urban traffic handling, it will have accomplished a useful purpose.

Bad Place to Try

POWER DEVELOPMENT from multiple-use water storage is surrounded by practical difficulties not yet fully solved. When a reservoir must be managed to leave ample vacant space for flood control or to store as much water as possible for river equalization, its possible use to generate power is subject to serious limitations. At best, much of the power will be secondary or dump power. This fact needs to be kept clearly in mind.

Fort Peck reservoir serves as a good example. Its primary purpose is to store water for navigation, with flood control and power generation holding second and third place. No generating equipment is being installed at present, but there is a movement on foot to have a power plant built, under the questionable premise that the power is needed in the mining region to the west from which Fort Peck now draws power for hydraulic dredging.

Assuming that power could be generated at Fort Peck and delivered to the distant mining region more cheaply than it could be produced there, the fact remains that continuous dependable power could not be generated at Fort Peck without releasing water when it should be held back to reduce floods and to supplement the low flow of summer months. Under the circumstances, Fort Peck appears to be a bad place to experiment with multiple use. When the need for power in its immediate neighborhood becomes such that an irregular supply can be used there may be reason to consider building a power plant.

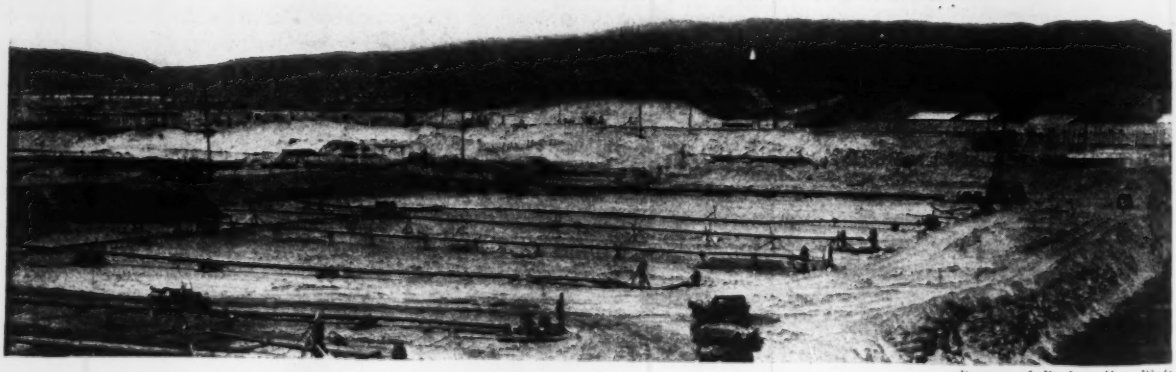
PICTURES IN THE NEWS

Bureau of Reclamation Photo

FRANK A. BANKS, construction engineer for the Bureau of Reclamation at Grand Coulee Dam, points out to President Roosevelt the progress made on the dam since his last visit in 1934.

LONDON gets a skyscraper (right). A corner of the new London University headquarters at Bloomsbury. The London code does not allow buildings above a certain height to be occupied, so nine floors in the great central tower, 220 feet high, can not be used until the building code is amended.

Wide World Photo



Bureau of Reclamation Photo

COLORADO RIVER bed unwatered. The overflow weir section of Imperial Dam, showing the installation of well-points pumps for unwatering the silt foundation. The dam is more than 60 per cent complete.

FIG. 1. UNDERSIDE VIEW OF McMILLAN ST. BRIDGE, CINCINNATI.

Rigid Frame With Vierendeel Bracing

by H. H. KRANZ,

Engineer of Highways, Department of Public Works, Cincinnati, Ohio

McMillan St. Bridge in Cincinnati is composed of four steel ribs of 117 ft. main span and 50 ft. cantilever side spans braced apart with open-web cross frames

IN PLACE of an old single-span wrought-iron Whipple truss built in 1899 to carry McMillan St. over Reading Road, Cincinnati motor traffic and street cars are now served by a handsome new bridge, modern in both its structural and architectural design. Not only was the old bridge too light and narrow for present-day needs, but its abutments had failed and, moving forward, had induced compression in the bottom chords. Its replacement, therefore, was urgent.

Opened to traffic during the past summer, the new bridge, on the same alignment as the old, is of steel rigid frame design. It has a main span of 117 ft., and the 30 ft. high legs also carry 50-ft. cantilever side spans. Of the transverse members, which connect the four ribs necessary to support the 44-ft. roadway and the two 8-ft. bracket sidewalks, half are rigid frames in the form of Vierendeel girders. These girders alternate with rolled section floorbeams. The bridge was designed for an H-20 highway loading plus street cars.

These structural elements—ribs and cross members—lend rugged simplicity to the bridge whose appearance also is enhanced by concrete pylons and a concrete railing. These concrete elements as well as the rails of stairways located at each of the four corners of the bridge are executed in the same architectural motif. The pylons, in addition to serving as ornamentation, provide supports for the trolley wire suspenders and for luminaries. There are eight such luminaries, one on the inner side of each of the large pylons over the sidewalks on McMillan St. and one on the outer side of each of the small pylons over the steps. The type of fixture used is a modification of a design originated by Robert Stock, assistant electrical engineer in the Cincinnati department of public utilities. No glass is used except that of the lamp bulbs, a diffused lighting effect resulting through reflection from aluminum vanes set on edge vertically around the lamps. The luminaries are designed to harmonize with the architecture of the pylons. Fig. 3 indicates how determined the engineers were to obtain accurate line and grade in the concrete work. Camber was placed in both the facia and railing, and there are no construction joints in the pylons above the pedestals.

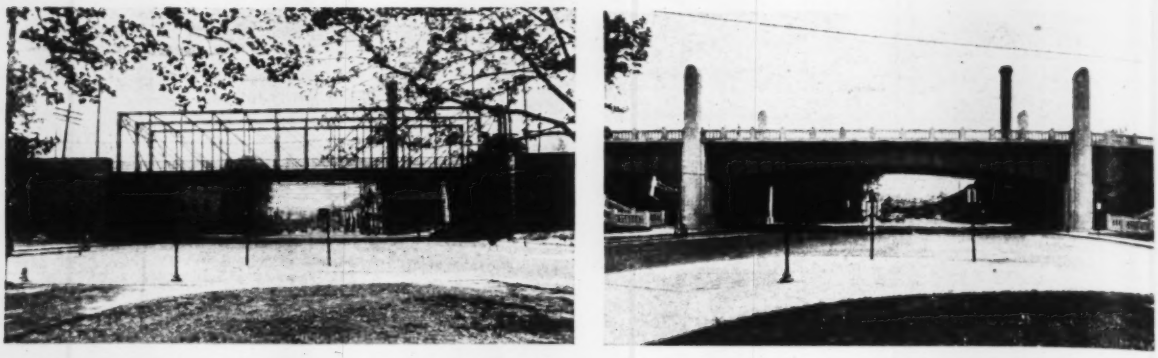


Fig. 2. Improvement is evident in these before-and-after views of the McMillan St. crossing of Reading Road in Cincinnati. In appearance, width, capacity and design, the new rigid frame bridge expresses modern practice.

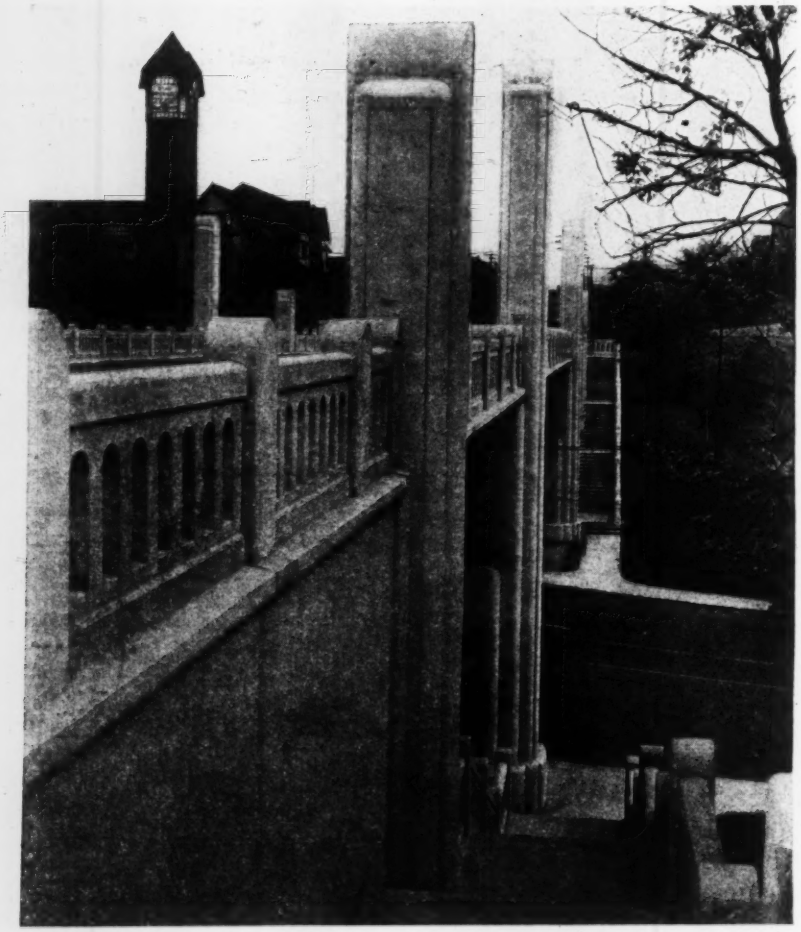


Fig. 3. Rail, staircases and pylons are executed in concrete. Extreme care was exercised in obtaining accurate line and grade in the facia and rail.

Each frame rib is made up of a $\frac{7}{16}$-in. web plate, 6 x 8 x $\frac{3}{4}$-in. flange angles and 13½ x $\frac{7}{16}$-in. flange plates in both the main and cantilever side spans. Splices consist of two $\frac{3}{8}$-in. web plates and 6 x 8 x 1-in. angles. From a depth of 9 ft. 9 in. at the haunch, the ribs reduce to 5 ft. at the center of the main span and also at the end of the cantilever. Leg makeup is likewise of $\frac{7}{16}$-in. plates and 6 x 8 x $\frac{3}{4}$-in. angles. Stiffener angles throughout are 5 x 3½ x ½-in. set on top of $\frac{3}{4}$-in. fill plates. Flange reinforcement at the haunches consists of three $\frac{7}{16}$-in. cover plates.

Details of the base hinges are shown in Fig. 4. The transverse bent in the plane of the hinges (Fig. 1) utilizes Vierendeel bracing, the cross members being made up of $\frac{7}{16}$-in. web plates and 3½ x 3½ x $\frac{7}{16}$-in. flange angles. The leg portions have a similar makeup. The Vierendeel girders, which serve as floorbeams (Fig. 1), utilize I-beams as "chords," (21-in. at top and 12-in. at bottom). At the ends the I-beam webs are split and the flanges curved to 12-in. radius to form the flanges of the end members. The web of these end members consists of two $\frac{3}{8}$-in. plates.

Bases in inspection wells

A unique feature of the design is the treatment accorded the bases of the columns, which rest upon hinges composed of cast steel shoes and 6-in. rolled steel pins. (Fig. 4.) The lower sections of the shoes are founded upon $\frac{3}{4}$-in. steel plates which are bedded upon pressed cork sheets $\frac{1}{4}$-in. thick, the cork having been placed upon the reinforced concrete footing. The hinges, being below the level of the sidewalks on Reading Road, are housed in reinforced concrete inspection wells, access being by means of manholes. These inspection wells are so arranged that they simulate pedestals for the columns and appear to be continuous with the pedestals of the four large plain concrete monoliths, the pylons.

The main east footing rests upon sub-footings which are carried to rock and shale about 15 ft. below the sidewalk. The main west footing, on the other hand, rests upon seventy-six 12-in. steel tubes which were driven open-bottom to rock or shale in the bed of former Deer Creek, about 40 ft. below the sidewalk. The tubes were cleaned during driving and finally were filled with concrete.

During construction of the new bridge, traffic on McMillan St. was

accommodated by a temporary steel and timber trestle built by the Cincinnati Street Railway Co. and decked over by the city. Reading Road, beneath the bridge, being an arterial highway which during the morning and evening rush hours also carries Cincinnati's densest local traffic including street cars, could only be blocked for a short period at a time. This fact dictated the location of girder splices and the following order for assembling the structural steel:

(1) Columns;

(2) Cantilevers to abutments (functioning temporarily as members fixed at the columns and free at the abutments);

(3) Cantilevers from each column projecting over Reading Road (followed in each case by the placing of the transverse members),

(4) Closing sections of the main span girders (four 12-ton, 59 ft. pieces), and the rest of the transverse members over Reading Road. These closing sections were placed between midnight Saturday and 7 o'clock Sunday morning.

The rigid frame girders were designed without support under the ends of the cantilevers for dead load. This greatly reduced the positive moment at the center of the main span. The ends of the cantilevers were supported when all dead load had been placed over the entire bridge. Thus there is no end deflection due to live load.

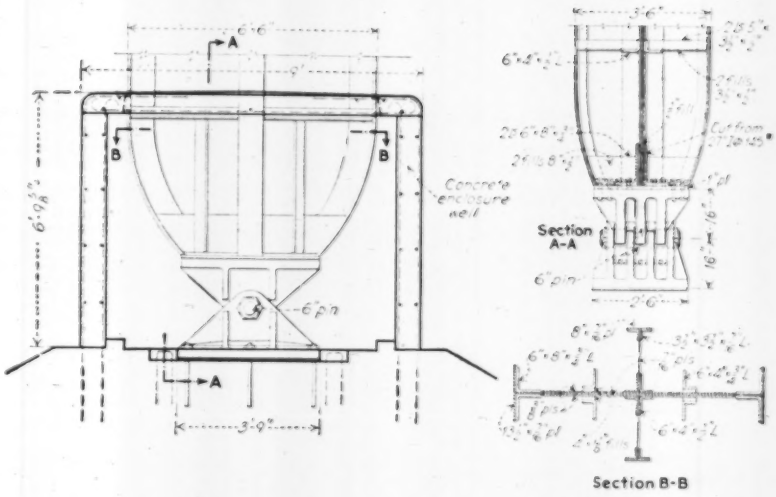


Fig. 4. Hinge and leg details of the rigid frame ribs. Hinges are housed in concrete inspection wells, so arranged as to simulate pedestals for the columns.

A very large amount of underground and aerial work was necessary in connection with the bridge work. Water and gas mains, high tension and telephone conduits, telegraph wires and street car feeder lines are not supported by the bridge but were detoured north and south on the city's right-of-way. Considerable sewer construction work also was required.

There were no serious accidents in spite of the heavy traffic both under and over the bridge construction. The total cost of the bridge and street improvement, exclusive of real estate, was $168,000, the PWA participating to the extent of $70,500. The Kerpen Construction Co., Cincinnati, was the contractor, and the steel was fabricated by the American Bridge Co. The bridge was designed by the city's regular structural engineering force in the division of highways. The architectural design was made by Maurice Schulzinger, the preliminary studies by F. Richard Hauber, the structural design by William Ivers, all under the general direction of Armin Aren, senior assistant structural engineer in the division of highways.

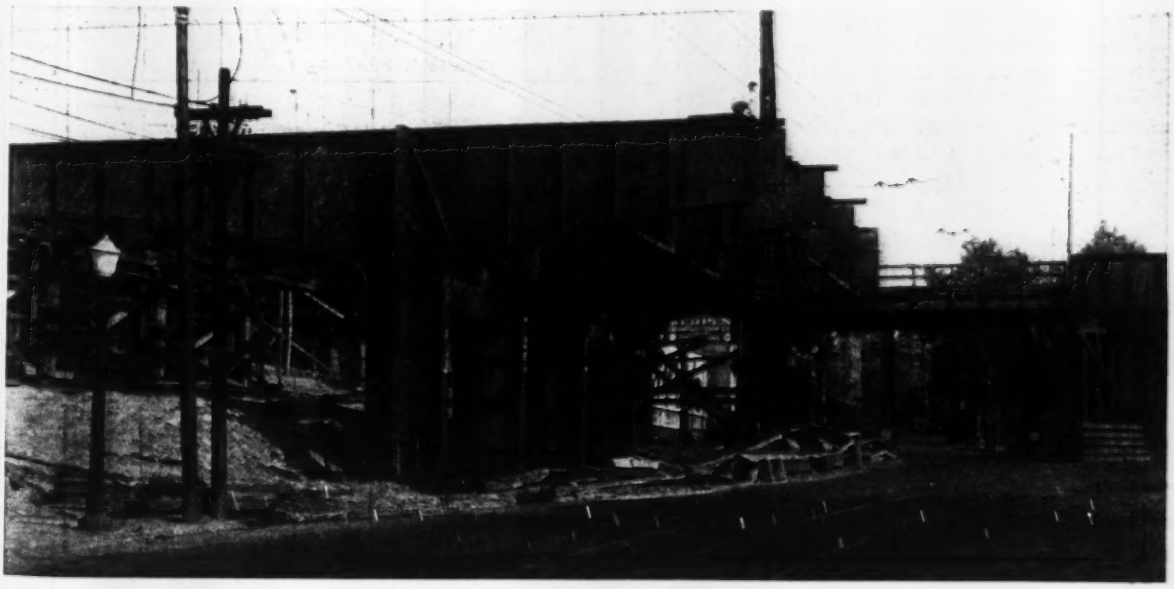


Fig. 5. Erection of rigid-frame ribs started with legs, followed by cantilever arms and was completed by placing 12-ton, 59-ft. center sections over the street that is crossed by the bridge.

The Moist Curing of Concrete

by H. J. GILKEY

Head of Department of Theoretical and Applied Mechanics, Iowa State College, Ames, Iowa

Data from a decade of testing establish proper curing and test conditions on a par with water-cement ratio in affecting concrete strength

MORE than eleven years ago, the author published a so-called universal curing diagram for portland cement concretes and mortars. (*Proceedings*, A.C.I., Vol. XXII [1926], p. 424.) For the most part, this diagram was based upon tests of 2 x 4-in. cylinders, and the maximum age covered was 3 months. The test results were consistent and ample to establish the qualitative correctness of the findings, but much follow-up work was needed before quantitative generalizations could safely be attempted.

During the intervening years, skeleton curing series have been incorporated with nearly all of the varied test series with which the author has been identified. These have included concretes and mortars of many aggregates and gradings, from several cements and for test ages up to a maximum of 4 years. Many of the tests were on 6 x 12-in. cylinders, while other tests have included smaller specimens, such as the 3 x 6-in. and 2 x 4-in. standard cylinders, as well as a non-standard 2 x 2 x 4-in. prism cast on its side like the cube but resembling the standard cylinder in ratio of height to lateral dimension. (*Proceedings*, A.S.T.M., Vol. 35 [1935], pt. I, p. 281–297.)

More or less as a final verification, a far more extensive series than any of the preceding has recently been completed, and it is felt that certain aspects of the curing phenomenon can now be presented with a degree of quantitative as well as qualitative assurance.

While the importance of curing and of that closely related factor, "the saturated or air-dry condition at test" is far better understood than formerly, the author suspects that there are few engineers who will not be startled by, and perhaps skeptical of, the very great range of strengths that can be developed by specimens cast from a single batch but cured differently, or in different moisture states at test.

We are so prone to think of the cement factor or the water-cement ratio as being the item that determines the strength of a concrete, that it is difficult to realize that by curing and test condition alone the one-year compressive strength may often be made to vary between 45 and 135 per cent of the standard-cured 1-yr. strength, moist at test.

Referring to the illustrative age vs. strength curves of Fig. 1, specimens standard cured (continuously moist and saturated at test) will give strengths corresponding to the very heavy curve, S.

If at any age a specimen is removed from its moist environment and subjected to ordinary air exposure, the strength increases quite rapidly during a period of from 1 to 3 weeks, depending upon the size of the specimen and the dryness of the air. This increase is due solely to drying since dry concrete is stronger than the same concrete if saturated. Gain in strength then ceases since the excess moisture necessary for continued hydration is no longer present. In some cases, the strength then remains nearly constant, although in many other cases there is a slow reduction in strength with added lapse of time, the strength eventually falling somewhere between the highest attained and that possessed by the concrete at the time it was removed

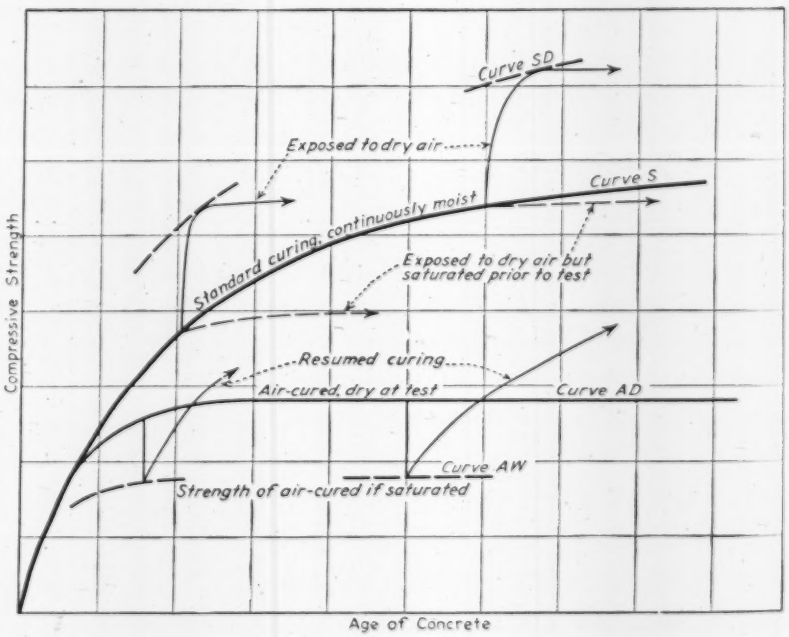


Fig. 1. Typical diagram showing the nature of the curing, air-drying, resoaking, and resumed curing effects on the compressive strength of concrete.

from a moist environment to dry air.

The heavy dashed lines at the top of Fig. 1, labeled SD (standard cured, dry at test) when connected form an upper envelop or locus of maximum attainable strengths. The compressive strength of each standard-cured, air-dried specimen rises to tangency with the curve SD and turns more or less abruptly to the right and continues horizontally or even somewhat downward from it.

That the increase in strength upon exposure to the air is a drying and not a curing phenomenon is demonstrated by its reversability. Re-saturation by immersion for from 12 to 24 hr., immediately reduces the strength to that upon exposure or to a still lower value if there has been retrogression with continued air exposure after the maximum strength was attained. Some retrogression seems frequently, though not always, to occur.

The SD envelop lies anywhere from 20 to 45 per cent above curve S.

Curve AD on Fig. 1 represents specimens, air-cured and dry at test. If the specimen after removal from the mold (presumably at the age of 1 day) is placed immediately in dry air, gain in strength ceases within a few days, and the strength remains virtually unchanged with further lapse of time. If, however, such a specimen be immersed for a few hours (12 to 24 hr. is adequate) the saturated strength is from 20 to 40 per cent below the dry-tested strength. The lowest curve, AW (air-cured, wet at test) represents the locus of the lowest strengths attainable for a given mixture, so far as curing and moisture effects are concerned.

Note that specimens cannot cure along either the curve SD, the locus of highest strengths attainable, or along AW. If an air-cured but saturated specimen remains moist, curing will resume as shown on the diagram.

Fig. 2 is a universal curing diagram from tests conducted on about 800 identical 2 x 2 x 4-in. prisms during the past two years. About 250 different ages, curings and test conditions are represented. Moreover, the key points on the curves are checked by a parallel skeleton series on 3 x 6-in. standard cylinders, and there were in addition a few 6 x 12-in. specimens as checks for air-curing and standard curing. The series from which Fig. 2 was plotted included, besides the air-cured and standard cured specimens at many test ages, specimens exposed to the air after periods of initial curing of half an hour, 1, 3, 7, 14, 28, 42, 56 and 84 days; 6, 9, 11 months, etc. and tested both dry and re-saturated at many test ages up to a year. In like manner, there were parallel delayed curing tests in which specimens were immersed for the first time at ages ranging from 1 day to practically 1 year.

The actual strengths are for present purposes of much less interest than are the relative strengths. The accompanying table supplies some of the more significant strength ratios for a variety of mixtures selected from among the many partial curing series of recent years. The abbreviations are those of the diagrams of Figs. 1 and 2; namely, *S* = standard cured, saturated at test; *SD* = standard cured but exposed to air from 2 weeks to several months prior to test; *SDW* = same, but immersed for one day prior to test; *AD* = air-cured, dry at test; *AW* = air-cured but saturated by one day immersion prior to test; *7S*, *28S* = tested at 7 or 28 days of standard curing.

Series A is that represented by Fig. 2. It was made from Iowa cement and Des Moines River sand. All the other series were cast and tested in Colorado, 1927 to 1930, and were from Colorado cement and aggregates, except that the aggregate of

TABLE 1—RESULTS FROM A FEW REPRESENTATIVE CURING TESTS.

Series	Size Spec.	Mix (Wt.)	W/C (Vol.)	Slump (in.)	Coarse Aggr.		Max. Age Approx.	Compressive Strengths at							Strength Ratios			
					Type	Size		7 da.	28 da.	Maximum Age					SD/S	SD/SDW	AD/AW	AW/SD
								S	S	S	AD	AW	SD	SDW				
A	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*I*	*J*	*K*	*L*	*M*	*N*	*O*	*P*	*Q*	*R*	*S*
A	2 x 2 x 4	1:2.75	0.80	9.5	None	.....	1 yr.	1,890	4,675	7,060	3,590	3,275	3,600	7,110	1.22	1.21	1.21	0.38
A	3 x 6	1:2.75	0.80	9.5	None	.....	1 yr.	2,680	4,580	6,540	4,230	3,140	3,380	7,040	1.28	1.19	1.35	0.38
A	6 x 12	1:2.75	0.80	9.5	None	.....	1 yr.	.....	.....	6,950	4,270	3,060	.....	.....	.....	.....	1.39	.....
B	6 x 12	1:2:3	0.80	7.0	Crush.	¾–1	6 mo.	2,600	4,210	5,120	3,190	2,520	6,080	4,605	1.19	1.32	1.27	0.41
B	6 x 12	1:3:4.5	1.10	3.0	Crush.	¾–1	6 mo.	1,320	2,150	2,830	1,500	1,030	3,545	2,325	1.26	1.52	1.45	0.29
B	6 x 12	1-4-6	1.20	1.0	Crush.	¾–1	6 mo.	1,020	1,680	2,520	1,320	960	3,130	2,160	1.24	1.45	1.38	0.31
C	2 x 4	1:3.25	1.00	8.0	None	.....	1 yr.	1,600	3,110	4,900	2,300	1,940	4,930	3,600	1.01	1.37	1.18	0.39
C	3 x 6	1:3.25	1.00	8.0	None	.....	1 yr.	1,820	3,200	5,230	2,650	2,200	5,270	3,730	1.01	1.41	1.20	0.42
C	6 x 12	1-3.25	1.00	8.0	None	.....	1 yr.	1,680	3,190	4,490	2,440	1,850	5,040	3,890	1.12	1.30	1.31	0.37
D	6 x 12	1:2:3	0.80	1.0	Crush	1–1½	1.5 yr.	1,810	2,810	4,240	2,480	1,985	5,440	.....	1.28	.....	1.25	0.37
D	6 x 12	1:2:0	0.85	9.2	None	.....	1.5 yr.	1,855	2,825	4,510	2,580	2,025	6,530	.....	1.45	.....	1.28	0.31
D	6 x 12	1:2:3	0.95	8.8	Crush.	1–1½	1.5 yr.	1,250	1,910	3,410	1,800	1,515	4,350	.....	1.28	.....	1.19	0.35
D	6 x 12	1:2:3	0.95	9.1	Gravel	1–1½	1.5 yr.	1,340	1,960	2,990	1,885	1,360	3,990	.....	1.33	.....	1.38	0.34
D	6 x 12	1:2:3	0.95	7.7	Crush.	¼–1½	1.5 yr.	1,420	2,480	3,890	1,955	1,410	4,440	.....	1.14	.....	1.38	0.32
D	6 x 12	1:2:3	0.95	8.7	Gravel	¼–1½	1.5 yr.	1,370	2,285	3,860	2,260	1,790	4,630	.....	1.20	.....	1.26	0.39
D	6 x 12	1:2:3	0.95	7.6	Crush.	¼–¾	1.5 yr.	1,420	2,480	4,150	2,310	1,695	4,625	.....	1.23	.....	1.36	0.37
D	6 x 12	1:2:3	0.95	9.5	Gravel	¼–¾	1.5 yr.	1,330	2,400	4,360	2,000	1,690	4,985	.....	1.14	.....	1.18	0.34
D	6 x 12	1:3:0	0.95	1.2	None	¼–¾	1.5 yr.	1,240	2,040	3,445	2,010	1,390	4,250	.....	1.24	.....	1.45	0.33
D	6 x 12	1:3:4½	0.95	0.0	Crush.	1–1½	1.5 yr.	1,270	2,335	3,215	1,910	1,395	4,160	.....	1.30	.....	1.37	0.34
D	6 x 12	1:3:4½	1.10	2.4	Crush.	1–1½	1.5 yr.	860	1,650	2,750	1,630	1,120	3,325	.....	1.21	.....	1.45	0.34
D	6 x 12	1:3:4½	1.10	1.0	Crush.	¼–1½	1.5 yr.	1,120	1,770	.....	1,710	1,125	3,730	.....	.....	.....	1.52	0.30
D	6 x 12	1:3:4½	1.20	2.8	Crush.	¼–1½	1.5 yr.	810	1,630	2,860	1,390	1,075	3,335	.....	1.17	.....	1.30	0.32
D	6 x 12	1:3:4½	1.20	6.1	Gravel	¼–1½	1.5 yr.	806	1,455	2,305	1,430	1,085	3,480	.....	1.51	.....	1.32	0.31

Specimens SD (Col. N) were for series:
A. Moist cured for about 11 months, followed by air exposure for about 3 weeks.
B. Moist cured for about 3 months, followed by air exposure for about 3 months.
C. Moist cured for about 8 months, followed by air exposure for about 3.5 months.
D. Moist cured for about 13 months, followed by air exposure for about 5 months.
Specimens SDW (Col. O.) were same but immersed about 24 hours just prior to test.

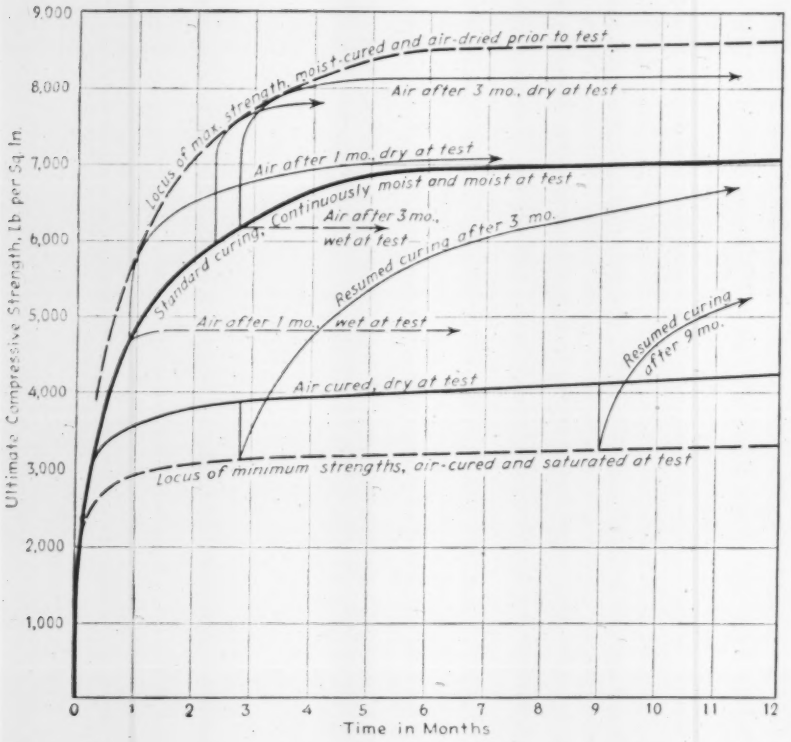

Ultimate Compressive Strength, Lb per Sq In.
Time in Months
Locus of max. strength, moist-cured and air-dried prior to test
Air after 3 mo., dry at test
Air after 1 mo., dry at test
Continuously moist and moist at test
Standard curing
Air after 3 mo., wet at test
Resumed curing after 3 mo.
Air after 1 mo., wet at test
Resumed curing after 9 mo.
Air cured, dry at test
Locus of minimum strengths, air-cured and saturated at test

Fig. 2. **Curing diagram for Series A of Table 1. Note that at 1 year the minimum strength is about 3,200 lb. and the maximum about 8,700 lb., a spread that results entirely from variation in curing procedure.**

Series C was crushed granite, 0–$\frac{3}{8}$ in. size from Stevenson Creek, California. The mixture and materials were identical with those used for the Stevenson Creek model dam tests.

A comparison of columns (*j*) and (*l*) of the table shows that the air-cured specimens tested dry, as cured, gave strengths at the maximum age that were always well below the 28-day standard cured strengths. The air-cured specimens immersed one day prior to test (column *m*) gave strengths at maximum age but slightly higher than those at 7 days from standard curing. Compared with standard curing at maximum age, the *AD* and *AW* specimens give strength ratios of about 60 and 45 per cent respectively.

The greatest ranges of strength attainable by variation in moist curing is from the *AW* locus to the *SD* locus which at maximum age gives a ratio of 30 to 40 per cent as shown in column (*s*).

The most significant showing of the table is the general uniformity of strength ratios for the wide range of mixtures, materials, gradings, and sizes of specimens. Referring to columns (*q*) and (*r*), it is apparent that the dry-tested strengths may be expected to over-run the wet-tested strengths by about 30 per cent with an even higher ratio occasionally. Fig. 2 seems, therefore, to be entirely typical of mixtures in general for a range of specimen size between 2 x 4 in. and 6x12 in.

An unprotected pavement slab or the thinner members in a reinforced concrete building subjected to dry heat, as in cold weather concreting, may dry out at least as fast as the air-cured specimens of these tests. Fortunately the slab or any other concrete exposed to the weather will subsequently receive moisture and curing will be resumed. Serious damage may already have been suffered, however, from use too severe for its initially weak condition. The building is unlikely ever to receive moisture for resumed curing. Only the exterior portion of massive members can seriously be damaged by lack of reasonable curing, although the retention of mixing water alone is not enough to insure hydration beyond 2 or 3 months at the most.

Specimens cured in air with the tight metal molds left on for the entire period and with tops and bottoms covered developed strengths at the end of 1 year corresponding to about 2 months of standard curing.

The increase of dry-tested over wet-tested strength in compression is amply demonstrated, not only by these tests, but by the extensive series of Gonnerman, published in the *Proceedings*, American Concrete Institute XXVI (1930), p. 359. In the same volume, p. 899, the author presents evidence that similar relationships hold for tension, torsion, and flexure.

Not all available data are in agreement that the flexural strength of

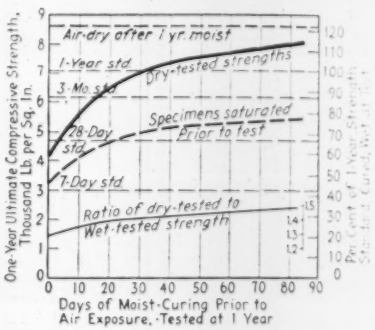

One-Year Ultimate Compressive Strength, Thousand Lb per Sq. In.
Air-dry after 1 yr. moist
1-Year std.
3-Mo. std.
28-Day std.
7-Day std.
Dry-tested strengths
Specimens saturated Prior to test
Ratio of dry-tested to Wet-tested strength
Days of Moist-Curing Prior to Air Exposure, Tested at 1 Year

Fig. 3. **Effect of different periods of initial moist curing and of dry or saturated test condition upon the 1-year compressive strength of Series A.**

beams increases with air-drying, which is probably explainable on the basis of the cracks or incipient cracks from drying shrinkage that may weaken the tensile face of the beam enough to offset or even exceed the increase in strength from drying. That the author's beams did show substantial strength increases from air-drying could well have been due to the smallness of the beams, which were 3 x 3 x 40 in. In such a small cross-section, differential shrinkages between the surface and the interior are much less than in larger members. The subject merits further investigation. The author knows of no data other than his own which supply evidence of the wet vs. the air-dry test condition for tension and torsion. The data of this paper deal only with compression, and flexure is mentioned only to point out that another factor (shrinkage) may account for seemingly contradictory behavior.

The great difference in the strengths along the *SD* and *AD*

curves over those along the *S* and *AW* curves might raise a question as to whether or not oven-drying would produce the same increase in strength as does air-drying. That is another story that will not be considered here other than to state that oven-dry specimens tested dry gave strengths about equal to the saturated strength prior to drying. Upon re-saturation prior to test the strength dropped 30 per cent or more below the initial saturated strength. There was little difference for oven temperatures below boiling and those well above it.

Reverting to the question of compressive strengths, Fig. 3 shows for the same series as that of Fig. 2 the effect, at the age of one year, of different periods of initial moist curing (standard curing) prior to air exposure. One month of moist curing, tested dry at 1 year, about equalled the standard cured 1-year strength. Upon re-saturation the strength was reduced virtually to that of the standard 28-day strength. Three months of moist curing followed by 9 months in air gave a 1-year dry-tested strength 15 per cent above the 1-year standard, but a 1-year wet-tested strength gave only 90 per cent of the 3-month standard strength.

The hearty support of the Iowa State College Engineering Experiment Station, T. R. Agg, director, has facilitated the conduct of the primary series of tests. To Dr. Glenn Murphy and, in lesser degree, to many others of his co-workers and former co-workers, the author is indebted.

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International Bridge Across Rio Grande

MEMBERS of the Texas state highway commission have discussed with a group of highway officials in the Mexican government plans for constructing an international free highway bridge across the Rio Grande at Laredo. An existing bridge connecting Laredo and Nuevo Laredo is privately owned and charges a toll.

Plans now being discussed call for sharing the cost of the proposed bridge between Texas and Mexico. Construction of the bridge would mark the beginning of a program for establishing other free international bridges on the Rio Grande at Brownsville, Hidalgo, Rio Grande City Zapata, Eagle Pass, Del Rio, Presidio, and El Paso.

Comparison of Ruby Dam Designs

by LARS JORGENSEN
Consulting Engineer, Berkeley, Calif.

Choice of an arch type as compared to gravity section has many advantages at Skagit River site

COMPARATIVE ESTIMATES for a straight gravity dam and a constant angle arch dam recently were made by the author for the structure to be built at the Ruby Dam site which is to create additional water storage on the Skagit River for the city of Seattle, Wash. At this site the canyon is narrow enough to make an arch dam efficient even up to a considerable height, and contract for the first step in the construction of a constant-angle arch dam at this site was let in August on designs made by the Seattle City Light Department. This first step will bring the structure to a height of 200 ft., the second step, to be contracted later, is to raise it to 400 ft., and the ultimate height is to be 625 ft. In the initial contract the base width of the dam is to be made adequate for the 400-ft. height to avoid necessity for again unwatering the river bed when the next lift is put on.

The maximum section of a constant angle arch for this site is shown in Fig. 2 on which successive steps are indicated. Fig. 1 gives the topography at the site and shows how the structure would be fitted to the canyon walls. The cross-section for the gravity dam used for comparison is assumed as a triangle with a base width equalling 95 per cent of the height for the high dam and 90 per cent of the height for the lower dams. Excavation depth for structures of both types was assumed as 30 ft. for each abutment, measured horizontally. For the lower height the full base width for dams of both types was included. The spillway is practically the same for both types and is not included in either estimate.

In the accompanying table are given figures to show the relative quantities and the relative safety against both sliding and overturning. By making similar estimates for other heights (say from El. 1,390 to El. 1,575) it can be shown that, for the same amount of money expended, the 3 to 1 ratio of storage in favor of the arch holds for a considerable range of elevation. If a fixed amount of useful storage is to be obtained, i.e., 3,000,000 acre-ft., the saving to be credited to the arch type, assuming ordinary costs, is about $5,000,000.

Considering first the safety of the gravity type structure, attention is given to tendency to (1) slide, (2) overturn and (3) shear. Results of computations on these points are given in the table. In figuring the safety against sliding the coefficient was assumed to be 0.75 times the weight. This calculation does not consider uplift which will be affected by depth of backwater—a depth that will vary from 0 to 105 ft. As there is no economical way of increasing this factor of safety against sliding the low value of 1.71 has to be tolerated.

Considering the same safety qualities for a constant angle arch at this site it is considered that all water load below El. 1,250 (150 ft. above the base) is taken by shear action in the contact area between rock and concrete. This assumption is made because the canyon is too narrow at the bottom for complete arch action to develop; extra material therefore has been added to provide for the shear. Under these conditions a safety factor of at least ten is assured.

Above El. 1,300 pure arch action is developed and the structure is designed to carry all the load on the arch. Because the structure is large the thickness of the arch necessarily becomes substantial and in the upper 75 ft. of the height, where the span is longest, the cross-section is almost equivalent to that of a heavy gravity dam. At a level 550 ft. above the

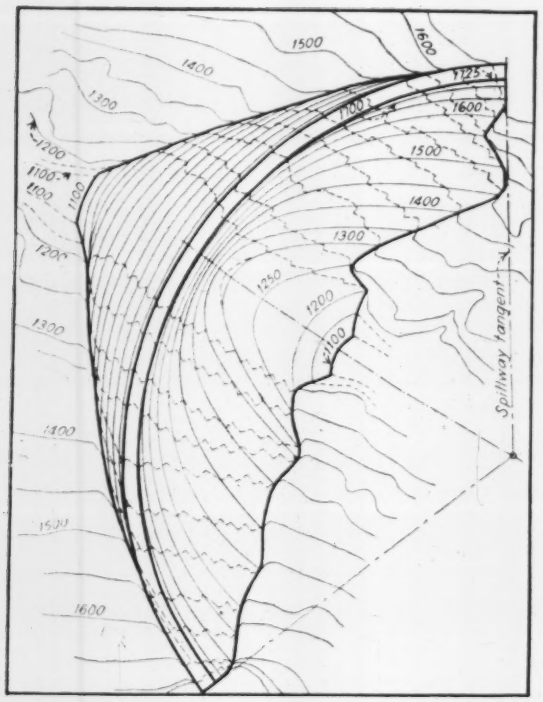

Fig. 1. Plan indicating manner of fitting the constant angle arch into the topography at Ruby Dam site.

base the ratio of arch length to thickness is 26. In this connection it should be remembered that until this ratio is more than 36 no "long column" action develops in an arch structure, according to demonstrations made with arch dam models by B. E. Torpen, some ten years ago.

For the arch design a maximum compressive strength of 600 lb. per and about 10 per cent less at the crown. Measurements made by Karpov and Templin on the Calderwood Dam in Tennessee indicated that for that dam, at least, maximum stresses at the crown were about 10 per cent higher in places than the stresses calculated by using Cain's formulas and assuming all loads carried by the arch. The abutment stresses measured during those tests were substantially lower than the calculated stresses, indicating that while a large part of the load was taken by the cantilever action at the abutments the same did not apply at the crown of the arch. The measurements also disclosed a large vertical tension on the downstream face of the vertical cantilevers near the crown for the upper three-fourths of the height, where calculations indicated that compression was to be expected. This discrepency between measured and computed stresses may be due to the fact that the usual calculations of arch dam stresses assume the structure to function as though it were cut into slices —an assumption which the Calderwood Dam tests indicate to be incorrect.

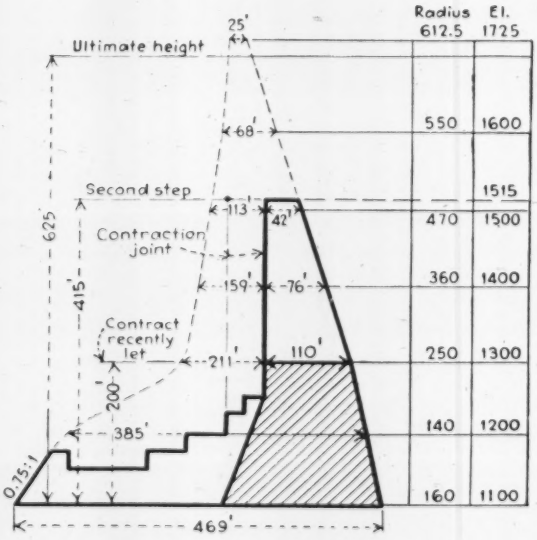

Fig. 2. Maximum cross-section of Ruby Dam showing proposed successive steps in construction.

In the design of the constant angle arch it is desirable to make use of overhangs in order to keep the upstream radii as short as possible and the subtended angles as large as possible. At the Ruby site the upstream face overhangs at the abutments a maximum of about 20 ft., and at the middle the center of gravity (if only the constant angle arch structure were considered) would overhang downstream. However, because of the thickening at the base to take the shear in the bottom of the canyon, as referred to previously, the downstream face of the dam does not actually overhang.

In the Ruby Dam designs the maximum compression stresses in the arch, both vertical and horizontal, have been kept under 600 lb. per sq. in., and the proportions are such that failure is not likely to take place until the crushing strength of the concrete has been reached. The factor of safety therefore should be at least 7 with ordinary quality concrete.

The fact that no arch dam ever has failed indicates the great reserve strength in such structures as compared to gravity dams of which 69 have failed to date, mostly by sliding. This "score" of 69 to 0 becomes the more impressive when it is realized that there are almost one-third as many high arch dams in existence as there are gravity dams of comparable height. Witness the compilation by Sutherland, *Engineering News-Record*, Dec. 10, 1936, p. 815, in which a table of dams over 100 ft. high lists 297 gravity dams and 90 arch dams.

COMPUTED VALUES FOR GRAVITY AND ARCH TYPES AT RUBY DAM SITE

Type	Ht. above El. 1100 (feet)	Concrete (cu. yd.)	Reservoir (acre-ft.) (effective)	Factor of Safety Against Sliding	Factor of Safety Against Overturning	Shear Load at Base (lb. per sq. in.)
Gravity	325	572,000	205,000	....	....	....
Gravity	625	2,940,000	3,000,000	1.71*	4.3*	143
Arch	420	550,000	630,000	....	....	....
Arch	625	2,090,000	3,000,000	†	†	31

* No allowance for uplift.

† Since an arch cannot slide or overturn without crushing the concrete, these factors could be expressed only in terms of crushing strength, which would afford a wide margin of safety.

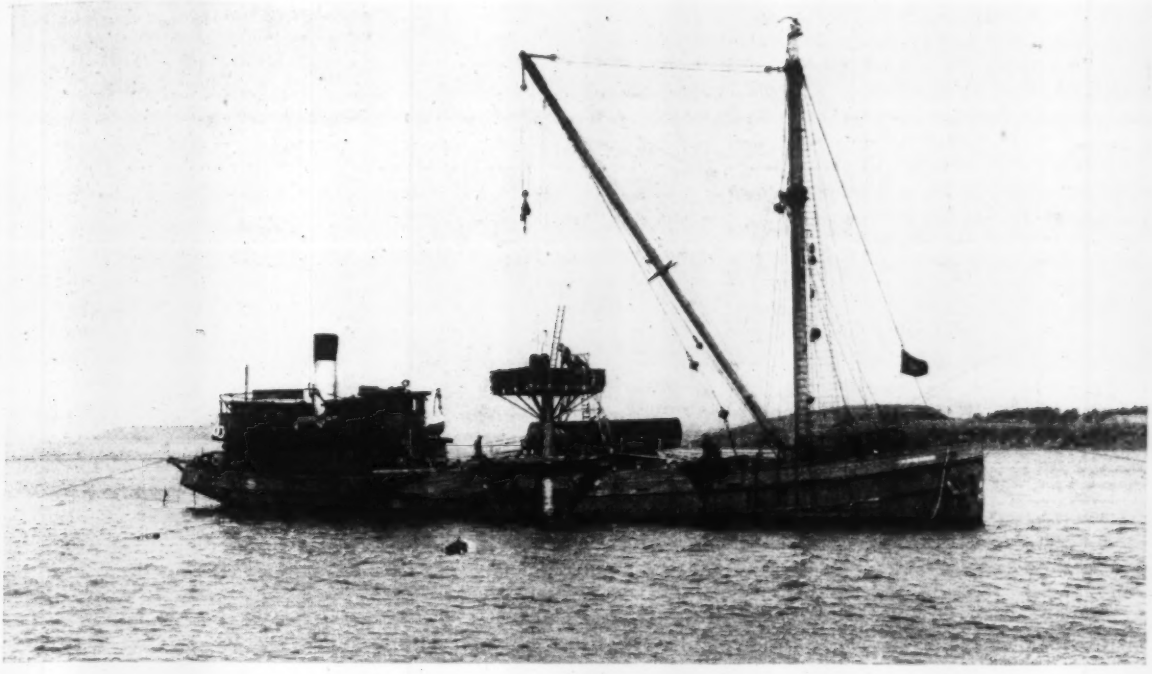

FIG. 1. DERRICK BOAT EUREKA EXPLORING THE OCEAN FLOOR IN COBSCOOK BAY

Foundation Exploration in Deep Water

by ARTHUR L. DOW

Formerly Associate Superintendent of Core Drilling—Passamaquoddy Tidal Power Development.

Soil sampling and core drilling successfully carried on in deep and swift-moving tidal waters of Passamaquoddy Bay with floating equipment

One of the most remarkable deep-water exploration operations ever attempted was carried on during the fall and winter of 1935–1936 as a preliminary to the then projected tidal power development on Passamaquoddy Bay in Maine. Though the project itself has been abandoned, it seems desirable to get on record the following description of the manner in which the underwater exploration work was carried to a successful conclusion for the benefit of others who may be faced with a like problem.

—EDITOR.

SOIL SAMPLING and core drilling on land and in non-tidal waters have been carried on frequently in the past in foundation exploration, but such operations have never before been undertaken in such deep water or under such adverse conditions as those met in the late fall of 1935 in determining the character of the ocean bottom along the line of the dam by which it was proposed to shut off Cobscook Bay for the development of tidal power at Eastport, Me. That project, familiarly known as the Passamaquoddy power project (*ENR*, April 23, 1936, page 583), called for the construction of six rock-fill dams across the outlets of Cobscook Bay, two of which were to be very large structures having a total length of over 7,000 ft. and heights up to 170 ft. above the ocean floor. This floor, for the greater part of the length of the dam, is of marine clay with a maximum depth to rock of 150 ft. The exploration work herein described was undertaken to determine the character and depth of this clay and the character of the underlying rock, thus affording a basis for estimating the amount of filling material required.

Adverse conditions to be met in carrying the work forward, in addition to the great depth of water, were a maximum tide range of 28 ft., reversing tidal current in excess of eight knots per hour, wind velocities up to 60 miles per hour, waves 6 ft. high, and at times, dense fog. Further, before the work was completed, winter brought sleet, snow and ice.

When the work was first proposed bids were called from private contractors, but when received they were found to be so far in excess of the government estimate that the Army Engineers decided to do the work with their own forces. John Sweeney,

an engineer with many years' experience in river and harbor work, was put in full charge of the design of the plant and of its operations.

Marine equipment

Two large derrick boats, the Eastern Chief, a former Navy boat used on salvage operations on the submarine S-51, and the Eureka, were engaged for the work. As the equipment on both boats was identical, the equipment of the Eastern Chief will be described. It is a derrick boat 120 x 62 ft., with a draft of about 6 ft., equipped with a large A-frame derrick with an 80-ft. mast and 96-ft. boom, having a lifting capacity of 125 tons on the main falls, and 20 tons on the whip. Boilers, engines, etc., are located aft, leaving a clear working deck of 70 x 62 ft.

To moor the ship for drilling operations, six anchors, varying in size from 5,000 to 13,500 lb., according to location and nature of the bottom, were used, as shown in Fig. 2. All anchors were equipped with pennants run to buoys to show their location in case an anchor line broke in a storm, also as a means for locating and picking up the anchors when they were to be shifted. Two anchors were run off the stern quarter, two off the bow quarter, and breast anchors off the starboard and port sides. The stern and bow lines were run to the ship's winches and the breast lines to hand winches. All lines were given from 1,200 to 1,500 ft. of scope and were hauled taut at low tide. With the long scope used no adjustment was necessary at high tide, the scope acting as a long hinge. Another result from using a long scope was ability to get two holes on the same range without shifting anchors for each move.

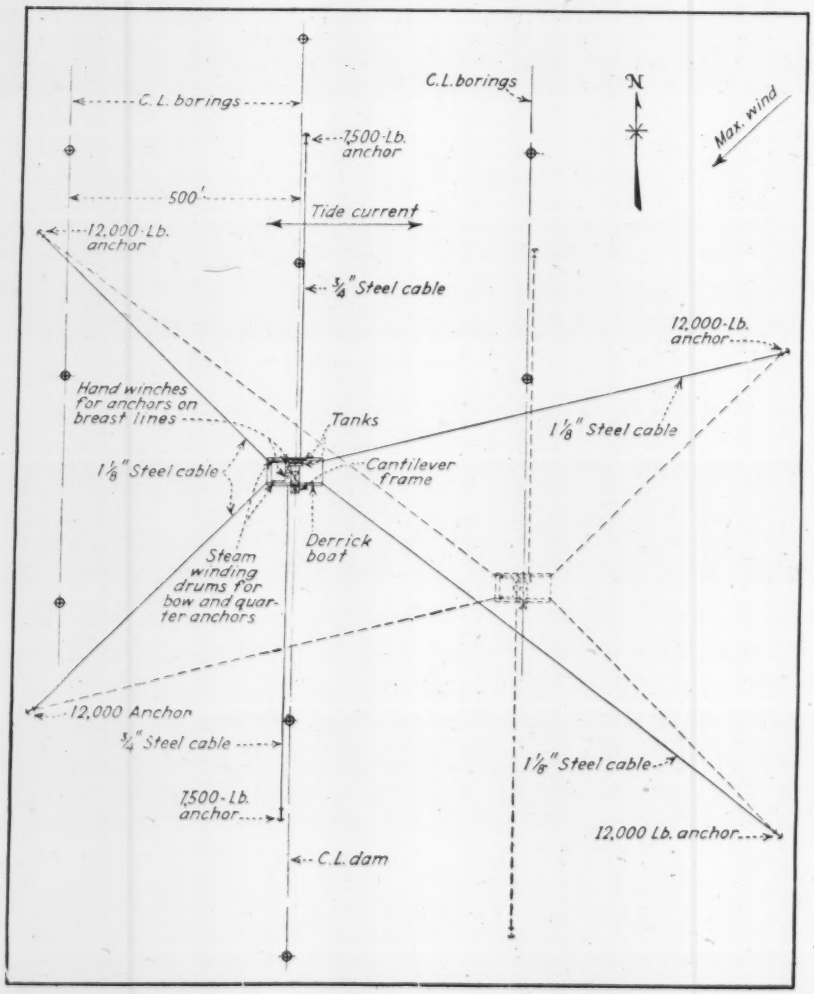

Fig. 2. Long anchor lines permitted the boats to rise and fall with the tide; they also simplified changes in position.

For support of the drilling spud and its working platform a cantilever frame was set up about the center of the length of the deck with its outboard members 16 ft. apart and extending over the starboard side of the boat a distance of 16½ ft., thus making it possible for the boat to move about 7 ft. in any direction in relation to the drilling spud without bringing any part of the boat or the frame into contact with the spud. Four tackles attached to the spud below this frame and to the outboard members of the frame itself were balanced by four similar tackles attached to the frame and to the spud above the platform. The leads from these tackles were controlled by hand winches on the barge, thus making it possible to compensate for changes in the elevation of the barge due to tide or for lateral movement due to wind or waves. This permitted considerable movement of the barge while maintaining the spud in a perpendicular position.

Near the bow and stern of the barge were additional outboard frames from which independent tackle lines led to the lowest set of lugs on the pipe spud. These tackles were of wire rope controlled by hand winches. They helped hold the barge in position. This arrangement is shown diagramatically in Fig. 4.

The spud used for the drilling operation was a steel pipe ⅞ in. thick and 21½ in. in outside diameter with heavy lugs welded to each section for the tackle lines previously referred to. The lower section of this spud was 50 ft. long. Other sections were of 5- and 10-ft. lengths that could be coupled on as depth increased. The 10-ft. lengths all were equipped with lugs for anchoring to the tackle lines.

The 50-ft. section was reinforced inside at its lower end with four H-beams 22 ft. long and extending 2 ft. below the bottom end of the spud, as shown in Fig. 3, the flanges of these beams being welded to the inside of the pipe for their entire length. The H-beams were chisel pointed in order to insure sufficient penetration to hold the lower end of the spud securely in position.

For assembling the spud, two 14-in. I-beams were put across the cantilever frame, one on each side of the spud position. The first section of the

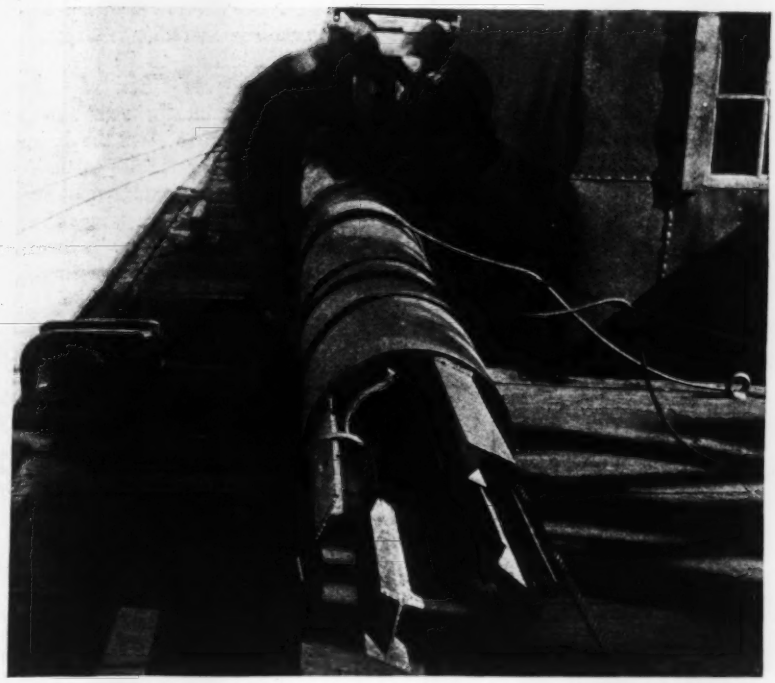

Fig. 3. The drill spud was of ⅞" steel reinforced at the lower end with H-beams.

spud was then lowered until its top was within about a foot of the I-beam and a wooden clamp of 12x12 timber, faced with steel, was bolted around it immediately under the coupling. When this has been done the falls were released and another section was swung into place and the joint made with heavy tongs. The whole spud was then raised slightly, the clamp shifted to a higher position and the spud lowered another 10 ft. This operation was continued until the ocean bed was reached. Pipe threads were well covered with pipe dope and the recess in the coupling was filled with heavy grease to prevent corrosion and to insure easy making and breaking of threaded joints.

The working platform was carried on a nipple that was fitted over the drilling spud after the spud had been seated on the bottom. Near the bottom of the drill spud was clamped a heavy steel mud pad 7 ft. in diameter to keep the spud from penetrating too deeply into the bottom. The location of this pad could be easily changed for varying hardness of bottom.

The operating platform was provided with a rail, racks for drill rods and tools, and footboards to prevent tools and supplies from rolling off the platform. A steam coil, flexibly connected to a line on the deck, served to keep the drillers warm and to thaw out equipment in cold weather. Heavy canvas windbreaks were lashed to the rail and a canvas canopy was provided over a portion of the platform.

The drilling machine and the platform were rigged with permanent slings so that in case of emergency they could be lifted off quickly by the derrick and set on the deck.

In general, the spud tackles gave little trouble in keeping the spud vertical and free of the barge. The general foreman watched two plumb bobs attached to the sides of the spud and directed the winch operators. On a rising tide, the upper tackles were gradually tightened and the lower ones slackened, while on a falling tide this procedure was reversed. The winches controlling the wire lines on the lower end of the spud required similar careful tending. It was found that less difficulty was experienced in holding the vessel and in maintaining the spud in a vertical position in deep water than in shallow water.

After the spud had been lowered to the bottom and a strain taken on all lines, the working platform was lowered over the top of the spud and clamped to it. Then a 6-in. extra-

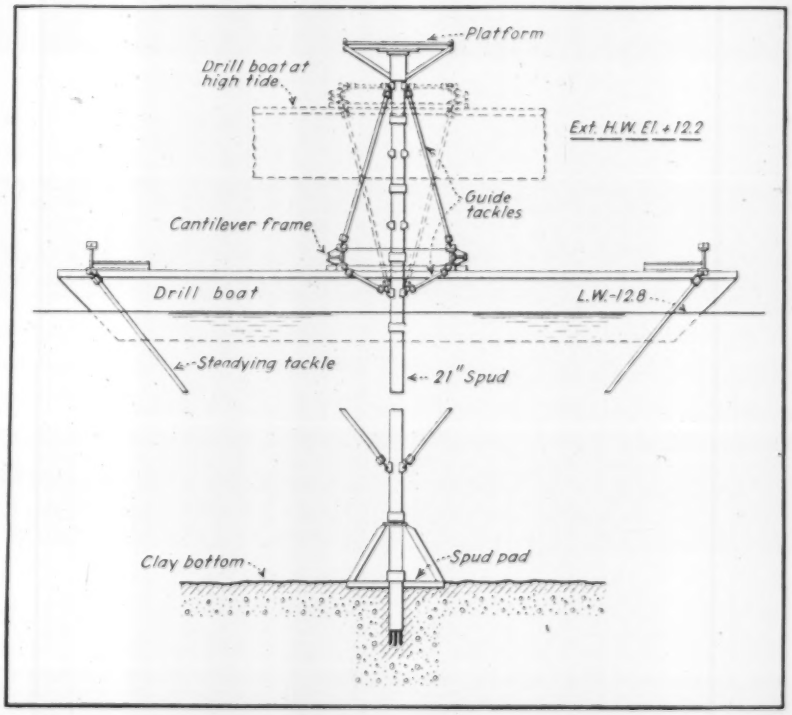

Fig. 4. Diagramatic arrangement of the boring rig which had to accommodate itself to a 24-ft. change in water surface.

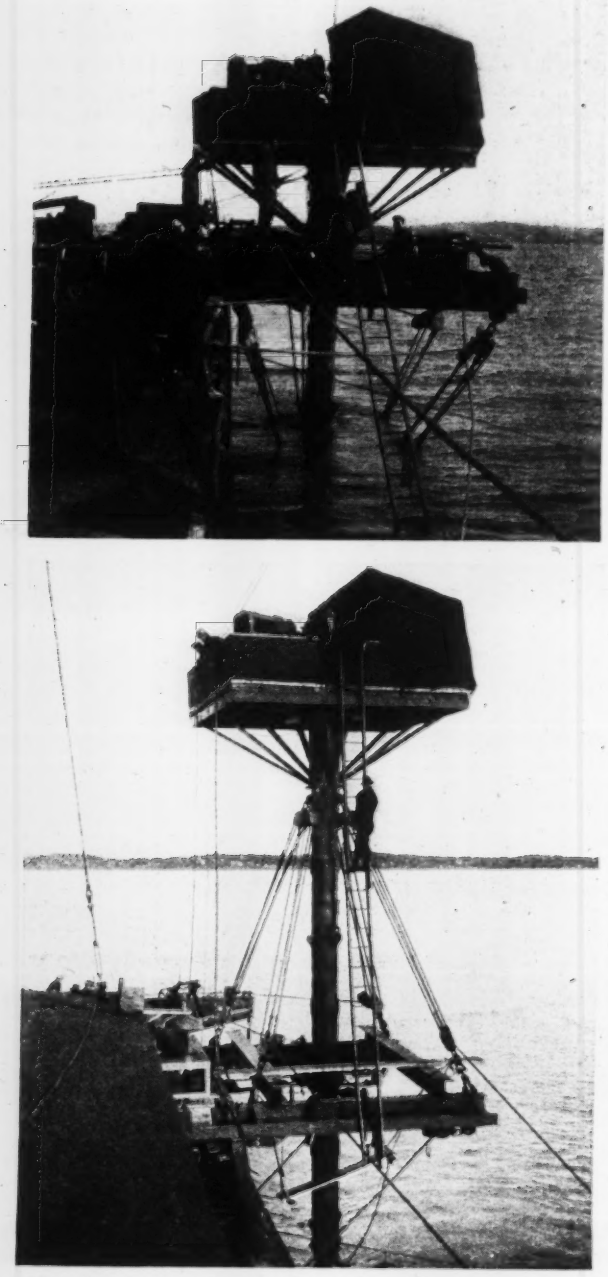

Fig. 5. A 24-ft. tide range called for wide flexibility in the rigging that held the spud in position.

heavy well-drill casing, made up of 20-ft. sections, was lowered inside the main spud until it reached the bottom and showed no settlement of its own weight. Subsequently a 5-in. sampling spoon carried by a drill rod was lowered to the bottom inside the well casing and forced for its full length into the clay bottom, pressure being applied with snatch blocks fastened to the working platform and pulling down on the drill rod carrying the sampling spoon. As depth increased, a 3-in. extra-heavy drill casing was substituted for the rod.

Drilling operations

Holes were drilled on three range lines, one along the center of each damsite and one at 500 ft. each side of the dam. The holes were staggered at 500-ft. intervals. Efforts were made to lay out the work so that it progressed from shallow to deep water with steadily increasing lengths of spuds. In shifting to deeper water, the platform was lifted off, slings placed, lower tackles removed, the spuds picked up to clear the bottom, and the steadying tackles to the forward and aft cantilevers were tightened. During high winds the H-beams and clamps were placed on the spud after it had been raised. The drill boat was then hauled by winches and mooring lines to a new position. Additional sections were added to the spud if needed.

Specifications for the work called for samples to be not less than 4 in. in diameter, and great stress was laid upon getting the samples to the soil laboratory in an undisturbed condition without having been subjected to shear, bending, compression or elongation. The specifications also require that wherever possible the sampling tubes were to be forced into the soil by continuous pressure rather than by driving.

Two types of sampling tubes were approved. The first was the "Vicksburg" tube developed at the Massachusetts Institute of Technology, shown in Fig. 6. The cutting edge formed by the collar on this tube provides both inside and outside clearance when the tube is forced into soil to relieve the friction on both the tube and sample and to minimize disturbance of the soil. A check valve at the top permits water to pass into the driving rod as the sample is forced into the mud and prevents its return to the top of the sample as the tube is lifted. The check valve also permits the formation of a vacuum to hold the sample in the cylinder during the lifting process.

Experience with the Vicksburg tube showed that the ball in the check valve is too small. An increase in the diameter to $\frac{3}{8}$ in. with a corresponding increase in the size of the opening would make the valve function more satisfactorily.

This type of sampler is provided with a loop of wire at the bottom which is supposed to function for cutting off the sample when the tube is ready for lifting. Experience showed that in sampling at such great depth where the platform, casing and drill string were subject to vibration and movement the cutting wire frequently is displaced or its

pull-wire gets tangled about the driving rod. After some experimenting its use was abandoned and no distortion of the material was observed.

The second type of sampler approved for this work was one developed by Mr. Sweeney and now on the market as a commercial product known as the "Maine" type of sampler. It consists of a simple 5-in. steel casing either 5 or 10 ft. long turned to a small shoulder on both ends and threaded with a machine thread to receive a detachable outside-bevel shoe on the bottom and a detachable head at the top. A check-valve in the top operates similar to that of the Vicksburg tube. The shoe has no shoulder on the inside.

The materials generally encountered were so plastic and of such a consistency that they would not ordinarily remain in the sampler with the maximum barrel length of 2 ft. used in the early stages of the work. This was due primarily to the jarring incident to unscrewing and removing the whole string of pipe required in securing the sample. To improve the sampling, new barrels, 5 and 10 ft. in length, were made up to fit the heads and shoes of both types of tubes. The longer barrels prevented the loss of the sample and apparently caused no more disturbance of the material than did the short barrels.

When the sampling tube had been removed from the hole, it was hung in a vertical position and compressed air was applied at the top. In very stiff material, the available air pressure of 150 lb. per sq. in. was insufficient at times to eject the material from the tube and water pressure of more than 250 lb. was required. On the other hand, very soft material sometimes would slide out too rapidly to permit obtaining a sample once the original friction had been overcome.

The lower end of the material as ejected was cut off and discarded. Subsequently the material for the sample was forced down, generally a distance of about 6 in., was dipped or brushed with paraffin and supported on a baseboard while being cut off at the end of the tube. A tin container, 8 in. in diameter, then was placed around the sample and filled with paraffin to above its top. Small samples for visual examination were cut at the same time and placed in bottles.

Fig. 6. The first soil sampler used was of the Vicksburg type.

The length of the specimen ejected from the sampler depended upon the plasticity of the material. If too great a length was ejected from the tube before being paraffined, the dead weight caused it to stretch and resulted in a sample of a diameter less than 4⅞ in. Similarly, soft material when placed on the baseboard slumped if its length was too great.

Each sample was labeled to show the hole number, location, depth, and date.

After a sample had been obtained, the 6-in. casing was forced to the depth of the previous sample, was cleaned out, and the sampling operation repeated. If it was not possible to force the casing down by the application of continuous pressure, it was driven with a 400-lb. drophammer. The sampling operations were continued until solid rock was reached.

Core drilling

After solid rock had been reached, the 6-in. casing was washed out and a 3-in. well casing was lowered to rock and spudded in. If large boulders were encountered it was necessary to chop through them with a chopping bit and force the casing on through to the rock.

Rotary rock drills were used, powered with 4-cylinder gasoline engines. Drill rods were of the A-type, 1⅝ in. in diameter, and producing 1¼-in. core. Single or double 10-ft. barrels and AX bits were used. The drilling machine as furnished had a screw feed with speeds of 200, 300 and 400 revolutions per inch, but it was found necessary to gear them to feed at 100 revolutions per inch to expedite the work.

The deepest hole drilled was in 120 ft. of water and through 164 ft. of overburden. In this hole it took about two hours to run and pull a string of drill rods. This naturally slowed down the rate of progress.

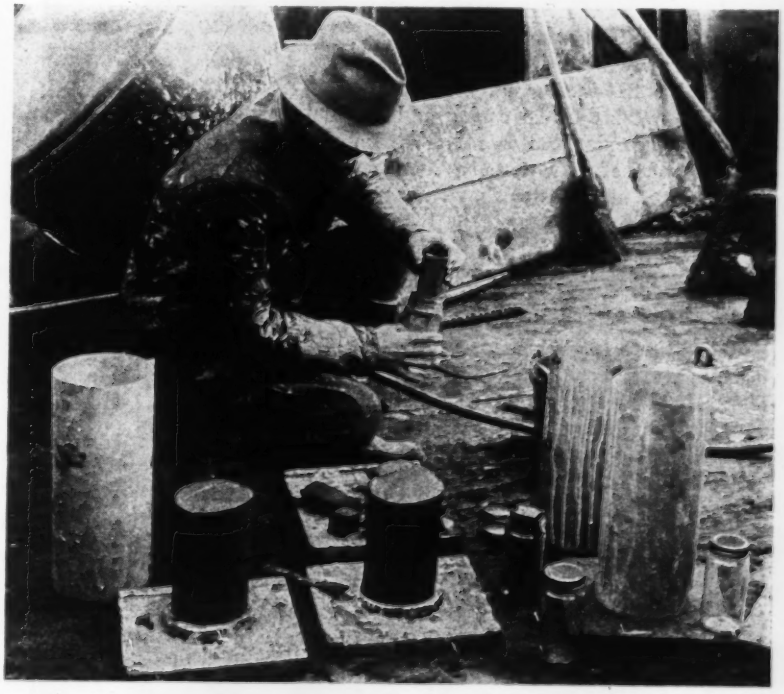

Fig. 7. Large soil samples were enclosed in steel shells and surrounded with paraffin. Samples for visual inspection were bottled.

Because of the great depth at which much of the rock had to be drilled it was believed inadvisable to use bits set with large stones. Also, few adequately trained diamond drillers were available, and as the great length of the spud and the movement of the mooring lines might make it impossible for even the most experienced driller to detect the loss of a diamond, which, becoming loose might quickly destroy expensive bits set with large stones, it was decided to use bits set with from 60 to 100 small bortz diamonds. It was found that round-shouldered bortz bits gave much more satisfactory performance both in recovery and in footage than the square-shouldered type.

When working in solid rock with few fractures no difficulty was experienced in operating or in core recovery with single or double-tube barrels. However, with worn bits the retaining ring was not spread sufficiently to allow the core to enter the inner tube of the double barrel. In badly fractured rock, as a rule, a double-tube barrel was more satisfactory.

Load tests

After sampling and drilling operations had been completed, a bearing test was run at the location of the deepest hole. To make this test, a steel plate was welded over the bottom of the 21½-in. casing, crushed rock was put inside the casing and the operating platform was loaded with sections of pipe until a load equivalent to 14 tons per sq. ft. was obtained.

Working crews

Operations were carried on with three shifts every 24 hours, seven days a week. Each boat carried a crew of 25 men per shift and was equipped with two-way radio so that it could be kept in touch with headquarters at all times (*ENR*, Dec. 17, 1936, p. 855). Emergency rations were maintained on the drill boats at all times for the supply of men marooned by rough weather. There were times when it was impossible to bring relief crews from shore, for periods as long as from 16 to 24 hours. During storms, the drill platform was removed and slings were put on the 21½-in. spuds, and the inside drill casing was held by a clamp across the top of the spud. A light strain was taken with the main falls, ready to pull the spud in case any gear gave way, but it never was necessary to pull the spud during a storm. Despite adverse weather conditions, ice and sleet, there were no losses of men or of equipment and no serious accidents.

The exploration work was carried on by the Corps of Engineers, U. S. Army, with Lt. Col. Philip B. Fleming as district engineer and Capt. Hugh J. Casey as head of the engineering division. John Sweeney was engineer in charge, Elmer Hoppe, assistant to Mr. Sweeney, and A. R. Reed and L. R. Small principal superintendents L. King, J. H. Hamilton and the author were assistant superintendents. Bruce Greenland was in charge of all inspection.

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Sponsors Buy Forty Per Cent of WPA Materials

PURCHASES of materials, supplies and equipment for projects of the Works Progress Administration reached a cumulative total of $446,378,503 on June 30, 1937. Of this amount, 41 per cent represents funds contributed by local governmental agencies sponsoring the projects.

The purchase of lumber and its products constitutes the largest item, aggregating $49,209,237, or 11 per cent of the entire amount. A total of $39,401,149 was spent for cement and $38,026,741 for paving supplies and mixtures. Large expenditures were made for sand and gravel, cast iron piping and fittings, concrete products, brick, hollow tile and other clay products, crushed stone, structural and reinforcing steel, and textiles.

All purchases from federal funds are made through the United States Treasury Procurement Division.

The attached table shows the types of materials purchased, the amount spent for each and the per cent of the total represented.

VALUE OF PURCHASES FOR WPA PROJECTS

Type of Material	Amount	Percent of Total
Lumber and its products	$49,209,237	11.0
Paints and varnishes	7,850,082	1.7
Sand and gravel	28,408,962	6.3
Crushed stone	22,781,836	5.1
Cement	39,401,149	8.8
Concrete products	21,783,347	4.9
Brick, hollow tile, and other clay products	22,042,774	4.9
Stone and glass products	16,776,997	3.8
Structural and reinforcing steel	22,428,121	5.0
Cast iron pipe and fittings	27,538,051	6.2
Plumbing equipment and supplies	5,265,360	1.2
Heating and ventilating equipment	4,445,494	1.0
Tools (excluding machine tools)	8,291,631	1.9
Other iron and steel products	21,991,417	4.9
Electrical machinery, apparatus, and supplies	9,081,801	2.0
Paving machinery, apparatus, and supplies	685,529	0.2
Motor trucks	1,229,246	0.3
Other machinery and equipment	7,816,081	1.8
Paving materials and mixtures—bituminous	38,026,741	8.5
Petroleum products	9,775,807	2.2
Office supplies and equipment	5,211,633	1.2
Textiles	32,732,971	7.3
Chemicals and explosives	5,787,139	1.3
Coal and other fuel, except wood and petroleum	1,933,737	0.4
Tires and rubber goods	1,116,138	0.3
Non-ferrous metals	2,247,612	0.5
Miscellaneous	32,490,610	7.3
Grand Total	$446,378,503	100.0

Efflorescence in Bricks Measured by Wick Test

A TEST for the tendency of building bricks to effloresce has been developed by John W. McBurney and Douglas E. Parsons of the National Bureau of Standards and is known as the wick test. In this test a whole brick is stood on end in ½ in. of distilled water for five days during which time it draws up water by capillarity just as a wick does. It is then dried in an oven at 105 to 110 deg. C. Finally, the brick is compared with an untested specimen and the amount of efflorescence, determined by visual inspection, is reported on a scale consisting of six classifications, ranging from an absence of efflorescence to an abundance of efflorescence.

What Is Good Water Worth?

A dollar-and-cents appraisal of the quality characteristics of public water supplies based on treatment plant investment

FEW NATURAL WATERS possess all the desirable characteristics associated with the term "pure and wholesome water." It is the objective of purification processes, therefore, to produce water which can qualify. To this end various forms of treatment may be employed which will render water free from disease bacteria, hardness, taste, iron and other undesirable constituents.

In an attempt to place a dollars and cents value on quality characteristics of public water supplies, Arthur L. Shaw and E. Sherman Chase, partners, Metcalf & Eddy, Boston, made an analysis of the economic loss resulting from impaired quality. Presenting their findings before the annual convention of the New England Water Works Association on Sept. 21, they stated that while conclusions were necessarily based on limited data, nevertheless these furnish a rough yardstick with which to gage the benefits of good water. The following is an abstract of their paper.

The appraisal of the health protection value afforded by the purification of a water supply, is a somewhat cold-blooded procedure. It is, however, a much more cold-blooded matter to neglect those precautions which make for a uniformly safe supply in order to effect an apparent economy in municipal administration. Furthermore, such neglect in a number of cases has proved to be false economy where substantial monetary damages have been awarded for deaths and illness due to infected water carelessly furnished by municipalities.

Olean paid for typhoid

An instance of heavy damages for typhoid paid by a city is described by Earl Devendorf (*Jour.* N.E.W.W.A., Sept., 1933, p. 298). Devendorf referred to an outbreak of waterborne typhoid in the city of Olean, N. Y., in 1928, in which 21 deaths occurred among 238 cases of the disease, following which and up to the beginning of 1933, $425,000 has been paid out for claims resulting from the outbreak. If the Olean experience can serve as a yardstick, any municipality responsible for waterborne typhoid is potentially liable for damages equivalent to about $20,000 per death.

Expressing the value of pure water in monetary terms, we may assume that the average annual saving in typhoid deaths in any one community due to pure water is 15 per 100,000 population, equivalent to $300,000 annually on the basis of the Olean settlements. With the average water consumption approximating 100 gal. per capita daily, this saving is equal to $30,000 per year for each million gallons of water supplied daily. In other words, if the

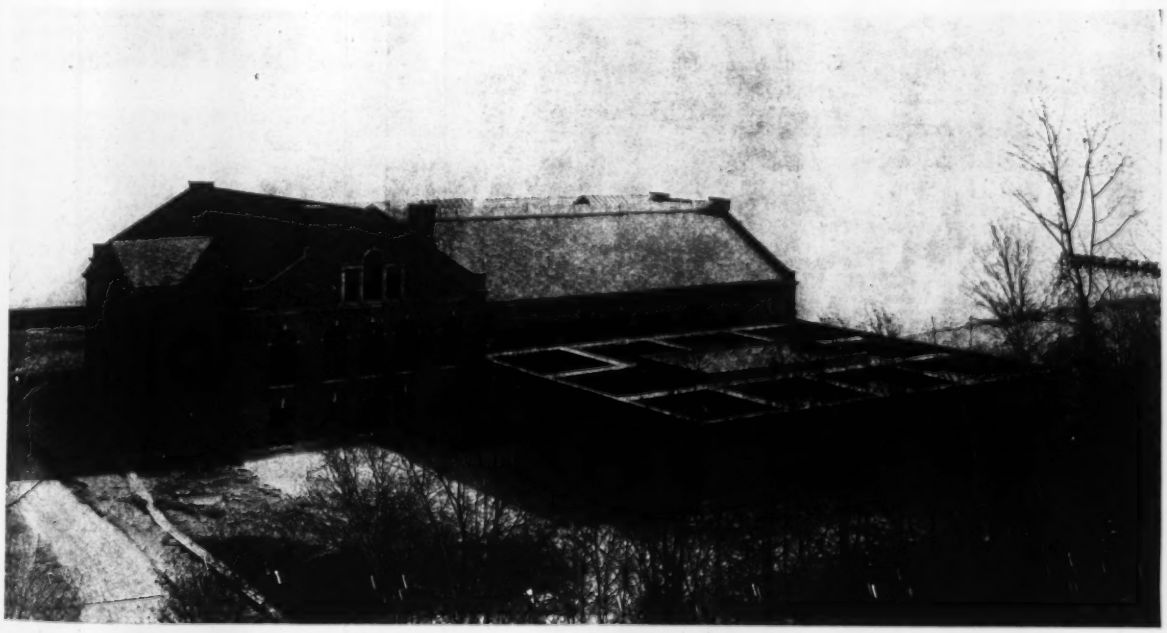

Fig. 1. **Safe water of good quality is assured where modern treatment plant, operated by competent personnel, are installed. This is the Highland Park (Ill.) Plant.**

sum of fixed and operating charges for water purification is not in excess of $30,000 annually per m.g.d. consumption, then the expenditure of this amount for purification is justified on the basis of economic saving to the community involved.

The value of quality

In view of the general safety of water supplies today it is perhaps of more interest to attempt the financial valuation of the physical and chemical qualities of a water supply. While it is far less important to furnish water of pleasing quality than to furnish a safe water, high color and turbidity, disagreeable tastes and odors and rusty water are the cause of customer complaints.

It is well known that in municipalities having water supplies possessing qualities displeasing to the consumers much money is spent for spring water for drinking purposes. The amounts spent depend upon the degree and character of the impairment. Disagreeable tastes and odors probably are responsible for the greatest expenditure.

The late Morris Knowles estimated several years ago that about 20 gal. of spring water per capita were purchased annually in Lawrence, Mass., as compared with 2 gal. in Boston, due to the unsatisfactory character of the supply of the former city. As ten cents per gallon is a reasonable figure for the cost of spring water delivered, it will be seen that a supply of objectionable quality may bring about annual expenditures for spring water ranging from twenty cents to two dollars per capita equivalent to about $2.000 to $20,000 per year per m.g.d. of water consumption. These figures represent the range in economically justified expenditures for annual charges for purification necessary to provide a water acceptable as regards tastes and odors.

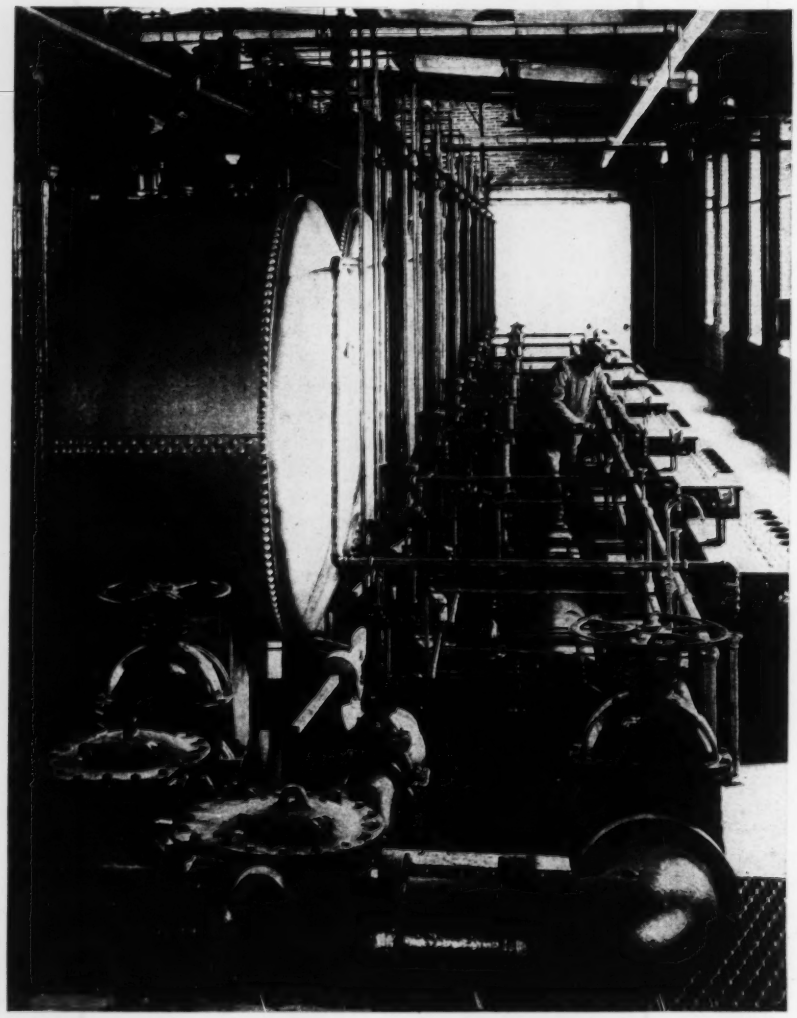

Fig. 2. To assure the maintenance of safe water, New Brunswick recently rebuilt its filtration plant with a $255,000 allotment from PWA.

Color and turbidity

To some extent, although not to the same degree as in the case of tastes and odors, high color and turbidity cause consumers to seek substitutes for public supplies possessing such characteristics. No data are available as to the extent to which color and turbidity cause the public to purchase bottled waters. As a matter of opinion only, it is not unlikely that a color of about 110 p.p.m. or a turbidity of 55 p.p.m. would result in the expenditure for spring water of an amount equivalent to that spent in Lawrence. Colors less than 10 p.p.m. or turbidities less than 5 p.p.m. are acceptable to the New England consumer.

Assuming that the purchase of substitutes as the result of high color in the public supply varies directly as the color increases between 10 and 110 p.p.m., with the higher color bringing about the expenditure of $2.00 per capita yearly for spring water, then each part per million of color above 10 represents an economic loss of two cents per capita per year or $200 per year per m.g.d. of water used. For turbidity in excess of 5 p.p.m., the corresponding figures would be four cents and $400, respectively.

To put it in another way, it may be stated that a municipality having a water supply with a color of 60 p.p.m. or a turbidity of 30 p.p.m. would be economically justified in purifying this supply if the total annual charges did not exceed $10,000 per million gallons of consumption. These figures are based wholly upon the use of the supply for domestic purposes and do not take into account the well-known economic effect of water quality upon many industrial processes.

Effects of corrosion

In the case of waters of corrosive qualities, it is almost impossible to estimate the economic loss which results therefrom. An example, how-

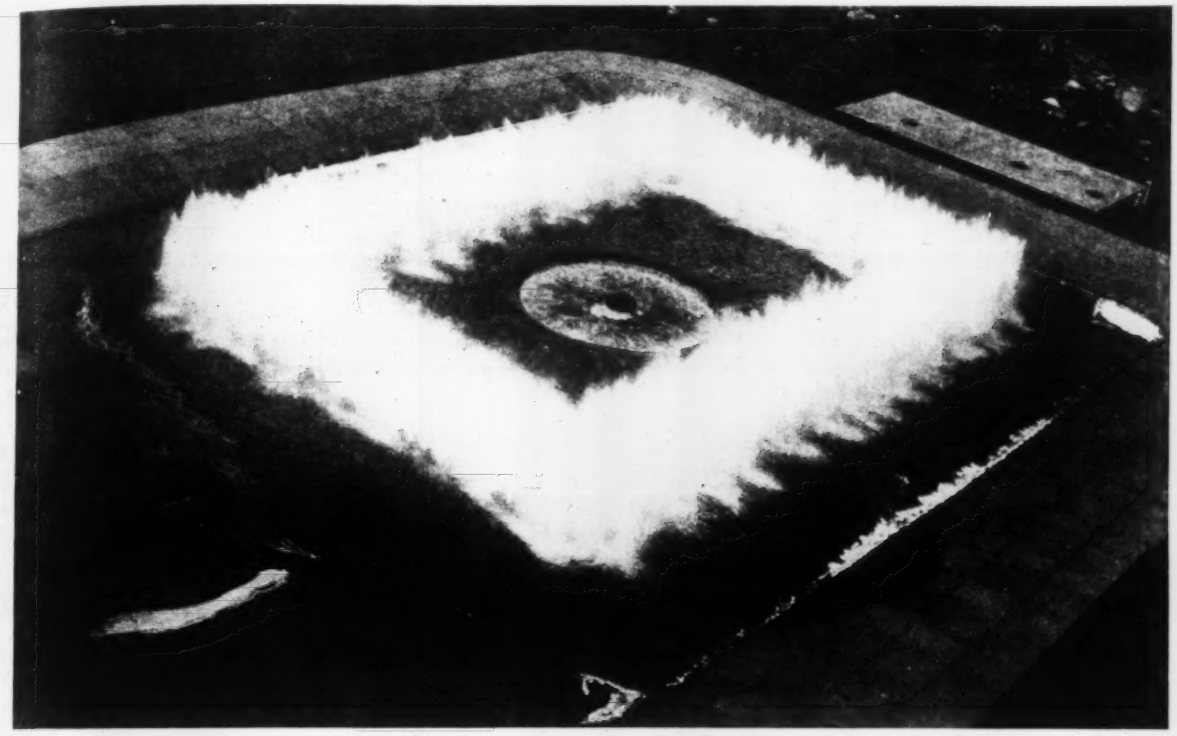

Fig. 3. Aeration treatment at the Providence, R. I., plant improves the quality of an impounded water supply.

ever, may serve to illustrate some of the very great losses which may be involved.

A certain municipality has a water consumption of 850,000 gal. daily. Corrosion of the mains is so rapid, particularly after cleaning, that recleaning is necessary about every three years to maintain their capacity. Cleaning costs average about 9 cents per lin. ft. and if done every three years means an average annual expenditure of 3 cents per ft. In this particular municipality there are over 100 miles of mains, which, if cleaned on the average of every three years, would result in an annual cleaning cost of about $16,000.

In addition to the effect of this corrosive water upon the public mains, there is serious impairment of service and household piping. There are about 3,100 services in this town representing, in all probability, some $300,000 value in inside and outside piping. It is conservative to estimate that the corrosive effect of the water cuts in two the useful life of these pipes. Assuming an average normal life of 20 years, the resulting loss from the shortened life of services and inside piping is $15,000 annually.

The total annual loss due to corrosive water in this town becomes then $31,000, equivalent to $36.500 per year per m.g.d. consumption.

Gradations in degree of corrosiveness cannot be expressed quantitatively with accuracy. Furthermore local conditions such as length of mains, character of pipe and pipe linings used, and water consumption greatly affect the extent of loss due to corrosion. It is therefore impossible to suggest even a rough yardstick for measuring the economic loss resulting from corrosive water. Each case must be considered separately.

The cost of hardness

Some years ago the authors made a study of the cost to the water consumers of Dayton, Ohio, of using water having 350 p.p.m. of hardness instead of 100 p.p.m. such as could be obtained by means of a softening plant. Estimates indicate that annual losses due to excess soap and gas consumption, the cost of maintenance and depreciation of dual household supplies of soft water were $3.50 per capita, equivalent to about $150 per m.g.d. per part per million of excess hardness. In other cities with less hard water the use of dual systems of soft water may not be so likely to prevail and the Dayton figure may be unduly high. However, H. W. Hudson (*Jour.* of the A.W.W.A. May, 1933, p. 645) gives figures for excess costs of soap alone used in certain other cities with waters ranging in hardness from 70 to 555 p.p.m.; these indicate that the Dayton estimate was not too high when all the major harmful effects of hard water are taken into consideration.

Iron and manganese

While excess amounts of iron and manganese are of definite economic significance it is particularly difficult to estimate in money the losses involved. One method by which such

ROUGH ESTIMATE OF ECONOMIC LOSS RESULTING FROM IMPAIRED QUALITY OF PUBLIC WATER SUPPLIES

Type of Impairment	Annual loss per m.g.d. of water consumption
Sanitary quality	$20,000 per death from waterborne typhoid
Color	200 per p.p.m. over 10
Turbidity	400 per p.p.m. over 5
Corrosiveness	Must be computed for each case
Hardness	$150 per p.p.m. over 100
Iron and manganese	$1,000 per p.p.m.

an estimate may be made is to base it upon the cost of iron and manganese removed at Lowell, Mass. The treatment plant at this place cost about $20,000 per m.g.d. capacity in 1914-15, probably equivalent to about $40,000 at the present time. Operating costs were $8.50 per m.g. in 1927, the latest year for which data are available. Analyses of the state department of public health in that year show an average removal of iron of 3.2 p.p.m. but no figures are given for the manganese removal. Assuming, however, that iron and manganese were present in equal amounts, as early analyses show, and taking annual depreciation and interest at 8 per cent the cost of iron and manganese removal was equivalent to $985, say $1000, per year per million gallons for each part per million of iron and manganese removed.

This figure represents the cost of remedial action and may not show the real loss to the community were the untreated water delivered to the city. It is, however, based on one method of computing the economic depreciation due to a particular type of water quality impairment and is perhaps too low rather than too high.

In conclusion, it should be recognized that these figures are based upon very limited data and are not sufficiently accurate for general application. They do serve as a rough yardstick, however, to illustrate the serious economic losses which result from the delivery of public water supplies of impaired quality.

Ornate Decoration Cast in Arches

Intricate pattern formed in plaster is successfully reproduced in monolithic concrete

DECORATIVE TREATMENT of unusually intricate pattern was cast monolithic with the entire concrete arch in the domed ceilings of a recent addition to the mausoleum in Forest Lawn Memorial Park, Glendale, Calif. The arches occur in one of the corridors of a new unit where there are five bays of English Gothic type with star-vaulted ceilings. In each bay the ribs spread gracefully upward from the capitals of clustered piers along the wall; capitals and bosses are of floral design more fully elaborated in large central bosses at the crown of the vault.

Fig. 1 shows the forms for the concrete arches, built of plaster and placed in sections, with workmen sealing the joints between adjacent sections. It also shows the completed plaster forms after placement of the steel which is to constitute the arch reinforcing.

No admixture was used with the cement nor was the concrete vibrated. The mix was slightly wetter than normal, and great care was taken in placing the concrete so as not to disturb the delicate form pattern, nor to cause displacement in alignment of joints between sections of the plaster forms which were solidly supported on heavy falsework. All details of the ornamentation were formed in a single pour; that is, no pre-cast units were set in the forms.

Despite the intricacy of the pattern and the amount of detail, the concrete of this ceiling was found, on removal of the forms, to be without visible defects other than some very small water voids on the surface and fins along lines where abutting sections of some of the forms had separated slightly. After correction of these imperfections the surfaces were cleaned and sandblasted.

Fig. 2. Decorative arch treatment as seen from the under side after plaster forms were removed.

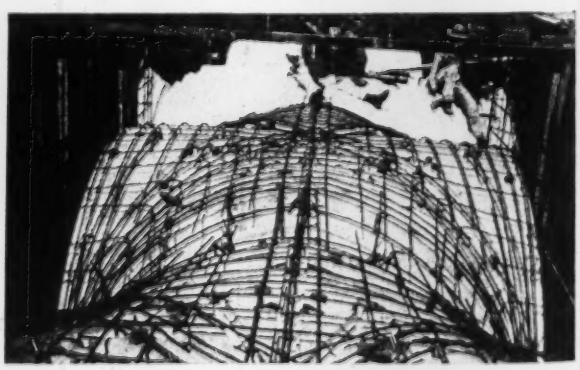

Fig. 1. Workmen sealing joints between sections of the planter forms. (At right) Completed plaster forms in place overlaid by reinforcing steel for the arches.

Highway Officials Report Progress

Delegates from forty-five state highway departments discuss advances in highway construction and operation in convention at Boston, Mass.

ENTIRELY NORMAL procedure characterized the 1937 annual meeting of the American Association of State Highway Officials held Sept. 27-30 at Boston, Mass. Membership in the association is by state highway departments and the federal bureau of public roads. Its work is carried on through 16 standing committees and special committees called together as current problems call for action. By this organization association work proceeds steadily and not intermittently at annual convention periods. In convention the association acts in general sessions only to receive formal papers and transact business; the technical deliberations are centered in sectional sessions headed by committee chairmen which are virtually hearings on the committee work, and in executive sessions of the standing committees. Convention proceedings, therefore, are reviews of progress and planning for committee work ahead.

As stated procedure at the Boston meeting was entirely along the routine indicated. Six formal papers were presented in five general sessions, and are briefly summarized.

The year's figures

Secretary W. C. Markham's annual report stated that in 1936 15,483 miles of state highways were added in this country, making the total on Jan. 1, 1937 444,676 miles, or 14.6 per cent of the total state road length in the nation. Eighty-four per cent of the state highway mileage is surfaced, a slow gain of 2 per cent over 1935 due largely to the increased mileage of unimproved roads added to the state systems. Delaware and Massachusetts report 100 per cent dustless mileage or better. Net total receipts from motor vehicle fees were $361,510,000, of which $46,603,000 was diverted to non-highway uses. Total receipts from motor fuel taxes were $683,074,000, of which $119,408,000 was diverted to non-highway purposes. State highway departments expended $1,131,151,000 last year, or $282,796,000 above 1935. Exhaustive figures on receipts and outlays for highway work were included in the report, which stated that last year 3,393 bridges of over 20-ft. span were built and 858 railroad crossings eliminated by state departments. The breakdown of road improvements, revenues, gas taxes and the disposition of the "gasoline dollar" by states were extended features of the report. State systems now have 4,704 miles of 3-lane; 3,082 miles of 4-lane and 221 miles of 6-lane highways. The Federal Bureau of Public Roads was responsible for much of the data included with the exception of the gasoline dollar breakdown compilation. Secretary Markham showed that with the exception of 0.5 cent the entire dollar goes for gas in the tank and roadbed on which to drive the car more miles per gallon of gas consumed because of improved roads.

Senator Carl Hayden of Arizona telegraphed the convention urging united opposition to the diversion of motor vehicle and gas tax funds to other than highway uses.

A bit of forecasting

Thos. H. MacDonald, chief U. S. Bureau of Public Roads, read a paper entitled "What is Expected of Our Highways?" Full information to the public was urged in answer to the present trend of critical comment on construction and administration. The speaker predicted a tapering off in transportation development in the next quarter-century. It is estimated that automobile registrations will rise from 28,000,000 in 1937 to 37,000,000 in 1960, while in 1923 there were but 15,000,000. Speeds are 35 to 100 per cent higher now than in 1923. More local systems must be built to meet a need far greater than that for superhighways. Future highway development depends in no small degree on research, planning and surveys. Analysis of survey data is more important than the survey work already done. Grade crossing elimination on fast through routes is a major necessity, with low-cost protective devices.

Mr. MacDonald stressed the importance of technical training for highway staffs, pointing out that the bureau is continuing short courses in soil stabilization open to departmental engineers from the states, and including material on cement, asphalt, binders, aggregates, and handling methods. The speaker recommended the use of long-term bonds to pay for rights of way and additional land required in connection with important highway improvements, since high-cost land cannot be acquired from current revenues. He also advocated putting highway engineering organizations under a civil service "career" basis in order to stabilize such work and enable the public to capitalize on continuous experience in this field.

James Logan, chief highway engineer of New Jersey, opened the Tuesday session with a paper on the effect of federal legislation upon highway costs. He forecasted no substantial permanent effect on construction and maintenance costs due to unemployment compensation, social security and labor laws. The reason is that better designs, improved construction methods and the use of modern machinery, combined with deeper understanding of highway problems, materials and administration are reducing unit costs and bettering the quality of work done. Mr. Logan credited manufacturers, engi-

neering periodicals, professional societies and various publications for much of this gain. He emphasized the rapid obsolescence of construction equipment and declared that highway and bridge design should not be considered routine matters. Federal legislation may have an immediate upward effect on costs, but the opportunities for more economical methods are great and offsetting. In closing the speaker advocated itemizing highway maintenance costs in terms of design elements.

Soil stabilization problems and the need for research along physicochemical lines in this field were reviewed by Prof. W. J. Emmons, University of Michigan, in a comprehensive paper. The cooperation of laboratory and construction organizations is important in attaining closer control of the complex material and mechanical factors involved in subgrade construction, the author stated. Soil-cement mixtures and the combination of bitumens with soils offer promising fields of inquiry, as to manipulate treatments.

Contract construction urged

A vigorous plea for tne use of more contract construction in place of force account work in the building of town and county roads was made by Richard H. Hopkins, Albany, New York. The author urged insistence upon as high standards in town and county work as in state highway construction. He commented favorably upon improvement in the labor situation following abandonment of the idea that hand labor should be preferred to machine work as a means of increasing employment. Under present conditions the contractor has practically 100 per cent control of the quality of his work. The speaker commended the work of the PWA during the past three years, contrasting it with the "all time low" in construction efficiency associated with the now defunct CWA. Attainable economies are still to be realized in much road work, however, despite the fact that present costs are about 60 per cent of those in 1922 highway construction. The machinery of 1922 seems ludicrous when measured against today's standards. The author stated that there will always be frontier territory in this country for live men.

Turning to county and town work, Mr. Hopkins said that a large percentage of it is done by day labor, and that such units are too small for efficient engineering supervision. County departments headed by experienced engineers under the guidance of state authorities can do much to improve standards of work in the field. The author favored construction work by experienced contractors on a far wider basis in this area, using local labor to an appropriate degree. American labor is mobile today, and on state jobs can and has been drawn from a wide area, many workers returning home nightly in their own cars. This applies as well to opportunities in town and county work. The claim that county engineers can do work at lower cost by force account than by contract may be met by the fact that new and efficient contracting firms and methods are constantly arising to challenge the old organizations and practices.

Mr. Hopkins urged his hearers to defend their authoritative position in relation to highway work against all efforts to assume such standing by others. He declared that state highway men should bear more active parts in regard to legislation, taking their rightful positions as supreme authorities on all phases of highway work, fighting diversion of funds, and sitting in upon discussions of minimum wage laws, working conditions and advising in regard to highway financing. Contractors should be called into conference when important changes in contracts and specifications are considered; fairness to local business men must be borne in mind, construction setups improved and wage rates duly established with respect to local conditions with the aid of the contractor.

Utilizes contract method

Elmer Lawton, deputy commissioner, New York, questioned whether economy is as remote from the construction field as the previous speaker intimated. He asserted that the Empire State utilizes the contract method wherever possible. Smaller sized contracts increase the theoretical engineering cost. The speaker said that in some cases it may be desirable to establish wage rates by other than the local agency. Mr. Hopkins replied that his restrictions in regard to economy were aimed at the WPA. He then emphasized the need of more engineering in secondary road design and construction.

Data on the effectiveness of contraction joints in reducing cracks in limestone and in reinforced chert gravel pavements (in various cases 60 to 90 per cent cuts) were given by F. V. Reagel and F. N. Wray of Missouri. Blow-ups and corner breaks have also been prevented or greatly reduced. Expansion joints have eliminated blow-ups over an extensive mileage, but at the price of excessive transverse cracking of the pavement slabs. Fewer cracks appeared in reinforced pavements having expansion joints than where no reinforcement was provided. Expansion joints also had bad effect on subgrade soils in certain cases. The authors recommended cooperative fundamental research in the interest of more rational highway design.

Labor policy debated

A. L. Gemeny, Bureau of Public Roads, commended the recent trend toward inculcating esthetic features in highway bridge designs. His paper reviewed the advancement of engineering design and construction during the past generation, with its departure from routine layouts, increased knowledge of structural problems, improvement in materials such as silicon alloy steel with its 50 per cent higher strength compared with carbon steel at very small cost rise, availability of deep-rolled beams and better understanding of the use of concrete. H. M. Westergaard's solution of the problem of bridge floor slab loading, the speaker said, marks a notable forward step. The forthcoming "Manual of Bridge Practice," under Association auspices, was referred to as a contribution likely to enrich the resources of bridge engineers through its compilations and fresh data.

Senator David I. Walsh of Massachusetts addressed the closing session on Thursday morning, discussing the wages and hours problem as influenced by the Wagner Act, the Walsh-Healey Act and the proposed wage-hour legislation in Congress. He predicted the passage of wage-hour legislation in some form at the next session, and interpreted these laws as efforts on the part of the federal

government to prevent chiseling and sweatshop labor in competition with employers paying fair wages and providing good working conditions. The senator emphasized the point that there are but 250 establishments in the country employing over 2,500 persons each against 115,000 with less than 50 wage earners each. In some industries the hours vary from 38 to 56 per week for work on the same goods. Where the government must award contracts to the lowest bidder, the absence of suitable legislation opens the door for price cutting based on low pay and bad working conditions, he said. These enacted laws set up a government agency for collective bargaining.

Prof. W. T. Sutcliff, Boston University, director of the graduate division, College of Business Administration, took issue with Senator Walsh as to the need of federal regulation, contending that more might be gained by using state compacts. Less federal supervision and more intimate regulation by the states, he declared, would be better suited to normal changes in the social and economic status of the individual states being wrought by the automobile and its attendant facilities. Prof. Sutcliff gave many figures on the development of highways here and elsewhere, reviewing the economic results of roadway construction in relation to automobile, hotel and transportation industries, and depicting the bright and dark sides of these facilities as illustrated by the fading away of business in some fields and its growth in others. He advocated long-range highway planning which should take into account the adverse effect of competition on large existing investments in railroads, the imposition of more equitable financial burdens upon trucks using superhighways and other roads. Prevention of graft in highway expenditures was vigorously urged by the speaker, who closed with a plea for coordinated development of roads, more efficient spending of money in construction, and planning in recognition of a trend toward a static population in the United States at about the 150,000,000 level. Among his recommendations were uniform road rules, putting social above sectional interests, adopting a pay-as-you-go program, the adaptation of road construction to motor vehicle engineering rather than the reverse, fostering cooperative research work and measuring programs by their broader influence upon the body politic.

Bridge problems

Beginning several days before the meeting opened and continuing through the convention week, the bridge committee gave studied attention to a number of important problems. Chief among them was the necessity for inspection, repair and posting of old bridges and the allied question of bridge live loads. The old bridge situation was reported to be serious in a number of states, if not in all, and the committee is attempting to formulate the elements of a program to meet it.

The bridge committee under Chairman Albin L. Gemeny of the Bureau of Public Roads operates as an informal discussion group and, during the early days of its sessions, focused attention on chapters of its manual of bridge construction which is planned to supplement the existing specifications. Finishing touches were put on the chapter on concrete construction and work was started on the first draft of the chapter on foundations, which had been prepared by G. G. Wickline of Texas.

The discussion on old bridges was opened by William G. Glidden of Virginia who presented a set of detailed instructions and suggestions concerning bridge inspection procedure that is furnished to his field forces. California, according to F. W. Panhorst, has a department of bridge maintenance composed of 14 men which reports directly to the bridge engineer. Special forms have been prepared for recording the conditions of bridges, recommendations for repair, etc. An important item on these forms is a suggested date for the next inspection of the structure. The men of the maintenance group spend part of their time in the office so that they are in fact as well as in theory a part of the bridge department. The results of this office work are bridge lists for ready reference that give the highlights of each structure. Also, rating numbers are determined and painted on the bridges so that other highway department divisions can evaluate the bridges for their own purposes. The basic problem of the whole rating system is, however, still unsolved, according to Mr. Panhorst. It concerns choice of stresses to use in figuring the bridge capacity, and it also involves the live loads that should be permitted over the bridges.

The legal phase of the old bridge problem also gives rise to much uncertainty. In some states truck owners whose vehicles have damaged or destroyed bridges have sought to collect damages from the state. Indiana and Virginia, it was pointed out, however, charge the driver with responsibility and institute suit against him immediately. E. W. Wendell, bridge engineer of New York, pointed out that there is no doubt as to responsibility in his state since it is illegal for vehicles that are too heavy to cross posted bridges. To provide a more definite load limit, New York has posted its bridges by permissible axle loads rather than by total weight.

A paper by J. R. Burkey of Ohio introduced the subject of highway bridge design loads by describing a vehicle survey made in Ohio and the resulting change in design specifications. The survey revealed that over 80 per cent of Ohio truck traffic consists of a truck and a semi-trailer, so that the heaviest loaded axles are only about 12 ft. apart. Since the standard specifications space the trucks 30 ft. apart, the bulk of the heavy Ohio traffic obviously does not correspond. Therefore, to make the live loading in design consistent with actual practice, Ohio has coupled the two trucks together so that for an H-15 loading the lead truck exerts an axle load of 24,000 lb. and is followed at a distance of 12 ft. by a trailer axle of 18,000 lb.

In discussion it was pointed out that a majority of the states instead of using a revised 15 loading as in Ohio had designed most of their bridges for 29 live loads so as to provide an extra margin of safety. It is claimed that the additional cost is seldom important. The general consensus of opinion was that the committee should go slow in changing its standard highway loadings which now have wide acceptance. On the other hand, the constant attempts of the trucking industry to increase payload is a threat that must be met. C. B. McCullough of Oregon urged that every effort be exerted on the transport industry to adopt a load code.

THE WEEK'S EVENTS

Continued from page 622

Quabbin Work Goes On At Good Rate

The recommendation made last August by the Boston Municipal Research Bureau that work on the Quabbin extension of the Wachusett system of the Boston metropolitan water supply be slowed down as a means of reducing taxes because the per capita water consumption is not rising as rapidly as expected (*ENR*, Aug. 19, 1937, p. 292), has had no effect on the rate of progress on the project, inquiry by *Engineering News-Record* reveals. F. E. Winsor, chief engineer on the project, states that no unfavorable comment on the work has been received as a result of the research bureau's recommendation and that it would be poor economy to slow down the job now when about $42,000,000 of the $65,000,000 appropriation has been expended.

It is expected that the main dam at Quabbin reservoir will be completed in the fall of 1938; the dike is nearly complete now.

The Quabbin reservoir project to increase Boston's water supply was started in 1927 with the construction of a tunnel west from Wachusett Reservoir to an intake in the Ware River basin; the tunnel was completed in 1931. Between 1928 and 1931 the work was slowed somewhat by a court suit between Connecticut and Massachusetts, and the work was also slowed down by the water commission's desire to save fixed charges by keeping bond issues down to the amount required actually to meet the needs of the district. The Swift River diversion tunnel and the major part of the aqueduct extension from the Ware River intake to Quabbin reservoir were completed in 1935.

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Dangerous Stretch of Line Abandoned by C.P.R.

Construction of a new route through the Selkirk range near Revelstoke, British Columbia, is nearing completion and will permit abandonment of 2.5 miles of Canadian Pacific Ry. lines which have cost the lives of at least 22 men in recent years, and have caused the expenditure of thousands of dollars in clearing away rock and snow slides and in repairing track damage. Seventeen men were killed eighteen months ago while clearing a snow slide on the stretch of line to be abandoned.

The $250,000 project is being carried out by Dutton & Co. of Winnipeg. This is the second major expenditure by the C.P.R. in slide-elimination line changes in the Rockies; the first was the construction of the Connaught Tunnel to eliminate the Rogers Pass route.

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Financing Plans Established For Mexican Highway

An ultimate investment of about $11,500,000 has been agreed upon for the highway between Nogales on the on the northwestern border of Mexico and Guadalajara, Mexico's second largest city. Construction of the highway is to start in October.

Cost of construction will be shared between the federal government and the states through which the 1,193-mile roadway will pass. Bonds are to be issued in amounts sufficient to cover the cost of the work.

The work is to be carried on in three steps. The first phase, which it is expected to complete in a year, will make the road passable to traffic at all times and will cost about $500,000. A second step, completing all work except paving, will cost about $3,500,000, and paving of the highway will bring the cost to $11,500,000.

Construction of 11,300 ft. of steel, concrete and wooden bridges over 17 rivers is expected to cost about $1,500,000.

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First Upper Ohio Valley Flood Dam Started

Work began Sept. 23 on the $6,100,000 Crooked Creek flood control dam near Ford City, Pa., first of eight dams which are to be erected at a cost of about $50,000,000 to control flood waters in the upper Ohio basin. In order to hasten preliminary work, plans for a ceremonial beginning were abandoned when orders to begin work were received from the Secretary of War.

The concrete and earth dam, about 1,800 ft. long, is expected to take three years to complete.

Power District Is Held Government Agency

The U. S. Circuit Court of Appeals of San Francisco on Sept. 10 upheld the right of the Sacramento Municipal Utlity District to issue $12,000,000 in bonds for a power system on the grounds "that the Sacramento Municipal Utility District is an agency of government to the extent that it may exercise the power of general taxation."

In its ruling the court upheld a previous ruling by the Federal District Court of Sacramento, an appeal from which had been brought before the Circuit Court by the Pacific Gas & Electric Co. The electric company contended it was unfair for the district to tax the company's property to build a publicly owned system which would take away the company's business.

The bond issue was authorized by voters in the district in 1934.

Stephen Downey, attorney for the utility district, asserted that the decision was of great importance to utility districts throughout the country. He said that in the decision "the court upholds our theory that the distribution of electricity is on a par with the distribution of water."

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Jury Appraises Site Of Cajalco Reservoir

The amount that must be paid for the Cajalco reservoir site near Riverside, Calif., to be used for storage by the Metropolitan Water District of Southern California, was fixed by a jury recently after a trial that extended over the record-breaking period of ten months. The actual number of trial days consumed was 154. Defendants claimed values in excess of $4,000,000 for the properties, based on adaptability for reservoir purposes and for mining. The contention early in the case that the properties contained valuable deposits of tin ore was eliminated by stipulation later in the trial. The lands involved in the suit, made up of 22 parcels, total 1,534.3 acres, for which the jury decided payment should be made totaling $564,300 plus a payment of $79,000 interest.

Additional lands to be acquired for the same project include 245 parcels totaling about, 4,720 acres. On these lands the district has appraisals ranging from $49,000 to $52,000. The defendants have placed valuation, not considering reservoir adaptability, ranging from $337,860 to $568,566, or including reservoir adaptability, ranging in amount from $843,000 to $1,207,650.

Mathieu photo

NEW ROAD OVER THE ALPS

THOUSANDS of cars and buses have used L'Iseran Pass Road, last link of the "Route des Alps" since it was opened to traffic July 10. The new road, located in Savoy, France, a short distance from the Italian border, reaches an elevation of about 9,230 ft., making it one of the highest motor roads in Europe.

L'Iseran Pass Road extends from Bonneval-Sur-Arc to Val-d'Isere, a distance of about 18 miles. The only alternative route is 135 miles long. Construction was begun seven years ago, but because of the difficult conditions work was stopped at various periods.

At the base of the mountain on the Val-d'Isere side a sign indicates to automobilists the stations at which radiator water is available. The ascent is gradual on a hard surfaced roadway.

Golden Gate Bridge Losing Money

The Golden Gate Bridge is now operating at a loss and it will probably be necessary next year to levy on taxpayers to make up a deficit, it was reported at a meeting Sept. 22 of the directors of the bridge and highway district. Directors expressed the opinion that the loss was due to the competition of the ferries which were allowed by a recent decision of the California Railroad Commission to reduce their fares below bridge tolls.

The board was unable to reach a decision on the appointment of a new general manager.

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Good Progress Made At Parker Dam

Parker Dam construction crews are pouring concrete at the rate of 2,000 cu. yds. per day. When the 100-ft. mark was reached Sept. 18, more than 62,000 yds. of concrete had been placed. It is anticipated that the 260,000 cu. yds. of concrete required in the construction will be placed by February, 1938, at the present rate of progress.

Although 100 ft. above the bedrock foundation, the dam on Sept. 18 was still 137 ft. below the Colorado River surface level. The completed structure will be 320 ft. high. Excavation to a depth of 237 ft. below the surface of the river, involving the removal of about 1,500,000 cu. yds. of earth and rock was necessary to reach bedrock. This is regarded as the deepest excavation that has ever been made for a dam foundation.

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Engineer is Honored By Canal Zone

The postal service of the Panama Canal is issuing a postage stamp commemorating the achievements of the late Maj. Gen. William L. Sibert, builder of the Gatun locks and dam. The stamp marks the anniversary of the first operation of the three sets of double locks.

Major General Sibert was appointed a member of the Isthmian Canal Commission by President Theodore Roosevelt in 1907 and was assigned as engineer of the Atlantic Division in charge of the Gatun project.

General Sibert died in 1935.

Social Group Formed For Tunnel Men

An organization, "The Moles", has been formed "to provide voluntary aid and assistance to the members of the contracting and engineering profession; to promote and cement the past and future friendships and the spirit of fraternization among members," as an outgrowth of several get-together dinners of tunnel and construction men. Reginald H. Keays has been selected as the first president.

Mr. Harry A. Leeuw, superintendent for Allan Spooner & Son is vice-president; Mr. Albert V. Sielke, consulting engineer, is treasurer, and Alex M. Stagg, of the A. M. Stagg Lumber Co., is secretary. Among those who have subscribed to the formation of the Moles are: Ted Avery of Blaw Knox; E. E. Bell of U. S. F. & G. Co.; E. A. Herrick of Cornell Contracting Co.; Ray V. Spooner of Allan Spooner & Son; Elz. Hardenburgh of Public Service Co., N. J.; Harry D. Burchell, Realty Associates; Dave Ayers of Ingersoll Rand; John C. MacElroy of McElroy Steel Co.; James F. Sanborn, consulting engineer; James H. Fitzgerald, Concrete Machinery.

CALENDAR OF MEETINGS

NATIONAL SOCIETIES

AMERICAN WELDING SOCIETY, annual meeting and exposition, Atlantic City, N. J., Oct. 18-22.

OHIO CONFERENCE ON SEWAGE TREATMENT, Cincinnati, Ohio, Oct. 19-20.

CANADIAN INSTITUTE OF SEWAGE AND SANITATION, annual convention, London, Ont., Oct. 21-22.

ASSOCIATED GENERAL CONTRACTORS OF AMERICA, fall meeting of the governing and advisory boards, Ambassador Hotel, Atlantic City, Oct. 21-23.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION, annual convention, White Sulphur Springs, W. Va., Oct. 27-29.

HIGHWAY RESEARCH BOARD, annual meeting, Washington, D. C., Dec. 1-3.

THE ASPHALT INSTITUTE, national asphalt conference, Memphis, Dec. 6-13.

ASSOCIATION OF ASPHALT PAVING TECHNOLOGISTS, annual meeting, Memphis, Dec. 6-11.

UNIVERSITY OF KENTUCKY, road and street school, Lexington, Ky., Dec. 6-9.

REGIONAL AND LOCAL

SECTION MEETINGS, AMERICAN WATER WORKS ASSOCIATION:
New Jersey, Atlantic City, Oct. 15-16.
Southwest, Galveston, Texas, Oct. 18-21
California, Sacramento, Oct. 20-23.
Virginia, Richmond, Nov. 4-6.
Missouri Valley, Omaha, Neb., Nov. 4-6
Wisconsin, Green Bay, Nov. 8-10.

CENTRAL STATES SEWAGE WORKS ASSOCIATION, annual meeting, St. Paul, Minn., Oct. 21-22.

AMERICAN ASSOCIATION OF ENGINEERS, annual meeting of the Illinois Conference of Professional Engineers, Hotel Jefferson, Peoria, Oct. 22-23.

TEXAS PUBLIC HEALTH ASSOCIATION, annual meeting, Dallas, Nov. 1-3.

ELECTIONS AND ACTIVITIES

THE LEAGUE OF CALIFORNIA MUNICIPALITIES, at its 39th annual convention Sept. 13-16, elected R. M. Dorton, city manager of Long Beach, to the board of directors. Jean L. Vincenz, public works commissioner of Fresno, who retired as president of the League, was continued on the board of directors for another year. Officers of the City Managers' Division of the League were elected as follows: president, Richard Manley, of Upland; vice president, Fred Nighbert, of Bakersfield; secretary, William Pardee, of Monterey. The City Planners' Division elected Glenn A. Rick, planning engineer of San Diego, as president, with other officers as follows: vice president, Howard Bissell, of Stockton; secretary, Ford Harvey, of Oakland. Officers chosen for the Engineers' Division were: president, Charles J. Shoults, of Los Angeles; vice president, Harry Goodridge, of Berkeley; secretary, Vitruvis Elmendorf, of Pasadena. The new president of the League is Mayor Charles H. Mann of Anaheim.

J. I. CORNELL was elected president of the Fort Wayne, Ind., Engineers Club after the resignation at the September 23 meeting of Harry M. Witherow. Mr. Cornell will serve until the annual election of the club next May.

AN ORGANIZATION MEETING to adopt a constitution was held recently by the Virginia Society of Professional Engineers, affiliated with the National Society of Professional Engineers. Merrill C. Lee proposed more stringent laws in the state governing registration of licensed engineers and more thorough enforcement of the laws. W. S. Conlin, executive secretary of the national society, said that coercion by organized labor and organized industry threatened the professional status and the moral obligation to society of the engineer. E. J. F. Wilson was recently elected president; other officers are G. A. Peple, Jr., vice-president, and J. S. Miller, Jr., secretary.

AN INSPECTION TOUR of a section of the new Merritt Parkway in Connecticut, now under construction, was the feature attraction at a meeting late last month of the Connecticut Society of Civil Engineers. Describing the parkway to the 300 members after the tour, state highway commissioner John A. MacDonald said that plans will be proposed to the 1939 general assembly to construct several similar parkways in other parts of the state upon completion of the Merritt Parkway. The rigid frame grade separation bridges used on the parkway were selected, according to Leslie A. Sumner, engineer of structures for the state highway department, because for reasons of economy and beauty. No two of the bridges are alike, and all designs were created with the surroundings of the bridge in mind.

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License Examinations

NEW YORK: Examinations for professional engineering Jan. 24-26, and for land surveying Jan. 27, at Albany, Buffalo, New York and Syracuse. Applications must be filed Nov. 1.

PERSONAL

GEORGE R. FORMAN, formerly senior administrative assistant in the Jacksonville district of the U. S. Engineers, has been promoted to the position of principal administrative assistant in the Memphis district. Mr. Forman became a civilian employee of the War Department in 1914 when he joined the headquarters staff of the Ordnance Department, later becoming chief clerk in the Buffalo district.

KENNETH SPIES has been appointed sanitary engineer of Pennington county at Rapid City, S. D., replacing Fred Bennett who has resigned.

C. O. DOHRENWEND has been appointed instructor of civil engineering at the Armour Institute of Technology. Mr. Dohrenwend was formerly an instructor in the civil engineering department at Rensselaer Polytechnic Institute. He will continue research in the field of applied elasticity in a laboratory of photoelasticity and structural models which is to be established at the Armour Institute.

WALTER A. SCHAEFER, who has been in the engineering department of the Elizabeth, N. J. municipal water department, has left Elizabeth to take a sales position with the Rensselaer Valve Co. Mr. Schaefer was formerly associated with Ernest L. Meyer, Inc., civil engineers, on the design and construction of sanitary engineering projects.

R. J. MCMAHON has been appointed state reclamation engineer of Texas.

MILO S. KETCHUM, JR., has been appointed assistant professor of structural engineering at Case School of Applied Science. Mr. Ketchum is a graduate of the University of Illinois, and after graduate work there specializing in structural engineering, he worked as a structural designer for the Bureau of Reclamation on the design of the Wheeler Dam and the Grand Coulee Dam. He was then engaged by the Portland Cement Association to develop special methods of analysis for designers of concrete structures, and for the past year he has been associated with the firm of Ross & White, Chicago engineers and contractors. Professor Ketchum is the son of the late Milo S. Ketchum.

ALFRED C. BRUCE, principal engineering assistant in the Binghamton, N. Y. district of the U. S. Engineers, has resigned to take an executive position with the Worthington Pump & Machinery Corp.

FREDERICK K. WING has resigned from his position as chief engineer of the Niagara Frontier Planning Board at Buffalo, N. Y., which he has held since 1935, to devote more time to his private practice.

BERTRAM D. TALLAMY, who has been assistant engineer of the Niagara Frontier Planning Board at Buffalo, is now chief engineer, succeeding Frederick K. Wing who has resigned.

L. D. JONES, formerly an engineer in the Ohio highway department, has been appointed deputy engineer of Delaware County, Ohio.

ERNEST J. TOWNSEND, instructor in civil and mining engineering at the Michigan College of Mining and Technology, has been promoted to an assistant professorship.

A. J. WARNER, senior computer in the office of the city engineer, Seattle, Wash., has retired after 30 years.

DEAN WILSON has been appointed division engineer at Hannibal, Mo. for the Missouri state highway department. Mr. Wilson, who was formerly assistant division engineer in Jefferson City, has been with the highway department since his graduation from the University of Missouri in 1920.

CY BOND, county engineer of Crittenden County, Arkansas, has been appointed city engineer of West Memphis, Ark.

SAMUEL JACOBS, formerly of the Duplex Construction Co., has resigned to operate the Adirondack Excavating Co. at Glens Falls, N. Y.

HARRY E. STOCK, formerly associate structural engineer with the procurement division of the U. S. Treasury Department, has opened an office in West Terre Haute, Ind. for the practice of general engineering.

DAVID J. PEERY has been appointed instructor in mechanics of the Carnegie Institute of Technology. Mr. Peery was formerly instructor in civil engineering at the Missouri School of Mines and before that time was employed by the bureau of bridges of the missouri state highway department. He is a graduate of the Missouri School of Mines and the University of Michigan.

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Nile Bridge Bids Asked

Bids have been asked by the Egyptian Ministry of Communications for construction of a steel bridge over the Nile near the city of Kaf el Dayat. The bridge will have a swing span, and the entire structure will be built on foundations placed with compressed air caissons.

OBITUARY

JOHN B. SHINN, 55 a partner in the Washington, D. C., engineering firm of Jensen & Shinn, died in Washington Sept. 27. Mr. Shinn served in the surveyor's office of the District of Columbia from 1901 until 1918, becoming assistant surveyor in 1908. He resigned in 1918 to enter the army, and after several years practice in Richmond he opened his office in Washington.

CYRUS C. BABB, consulting hydrographic engineer of Granite Falls, N. C., died there Oct. 2 at the age of 70. Mr. Babb had served as a consulting engineer since 1917 for several large power companies and was also engaged on the War Department survey of the Catawba-Santee and the Yadkin-Peedee basin. Before entering consulting practice, Mr. Babb was for a time chief engineer of the State Water Storage Commission of Maine and was for many years connected with the federal government service as a hydrographer in the hydrographic branch of the U. S. Geologic Survey and as project engineer for the Reclamation Service. In that capacity he had charge of the preliminary work on the Milk River project in Montana. Mr. Babb was a past president of the Maine Society of Civil Engineers.

WILLIAM O. GENAGEY, for 22 years instructor in the college of engineering at West Virginia University, died Sept. 27 at the age of 54, while teaching a class.

GEORGE GREEN, Niagara Falls contractor, died in Niagara Falls Sept. 28. He was one of the builders of the Lower Arch Bridge at Niagara Falls and also of the Shredded Wheat plant in that city.

HENRY MASSART, Baltimore consulting engineer since 1911, died in Baltimore Sept. 29 at the age of 62.

EDGAR S. DORR, former chief engineer of the Boston division of sanitation and for 44 years in the employ of the city's engineering department, died in Dorchester, Mass., Oct. 5 at the age of 83. He was a graduate in 1875 of Massachusetts Institute of Technology.

FREDERICK C. TAXIS, St. Louis consulting engineer and a pioneer builder with reinforced concrete, died in Clayton, Mo., Sept. 24 at the age of 86. Mr. Taxis was consultant on the construction of the Arcade Building in St. Louis, which when it was built in 1917 was one of the tallest structures built up to that time on a frame of reinforced concrete. He was structural engineer for the Civil Courts building and the New Federal Building in St. Louis as well as many other important structures there. He was practicing actively at the time of his death.

JOHN W. SCOTT, New Orleans engineering contractor, died recently in that city. A graduate in engineering of Tulane University, Mr. Scott joined the firm of Nat T. Scott & Sons in 1906 and in 1926 organized the firm of Scott & Bros. He was connected with a number of public works projects, including the Galveston jetties.

M. H. WALSER, 30, a construction engineer for Marsman & Co., died Oct. 1 in the Philippine Islands, where he had been engaged in construction of a gold mine drainage tunnel.

HARRY S. MOORE, an engineer for the PWA at St. Louis, Mo., died there Sept. 29 at the age of 59 as a result of injuries received in an automobile accident.

JOHN SHEARER, 63, former superintendent of buildings in the department of public works in Ottawa, died recently in that city. Mr. Shearer entered the department of public works in 1903 as superintendent of dominion buildings, the title later being changed to its present form.

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Five-Year Plan Proposed For Washington Traffic

A FIVE-YEAR PLAN of street and bridge improvements to relieve traffic congestion in the city of Washington has been proposed to the District of Columbia Commissioners by the director of highways. Presented for consideration are a list of needed improvements aggregating $30,000,000 in cost, of which $20,000,000 would be expended during the five-year period. The amount conforms with expected receipts from the weight tax on motor vehicles imposed during the last session of Congress.

Included in the list are three short subways to carry street-cars beneath DuPont, Scott and Thomas Circles, a new bridge to carry Pennsylvania Avenue across the Anacostia River, an additional high-level crossing over Rock Creek Park, a high-elevel viaduct approach to the Key Bridge across the Potomac, and numerous minor grade separation, street widening and bridge replacement projects.

CONTRACT UNIT PRICES

What contractors are bidding on different kinds of construction work

SEWERS, GREAT BEND, KANS.

OWNER: City of Great Bend, Kan.; Paulette & Wilson, Topeka, Engineers.

PROJECT: Construction of 4 miles of sanitary sewer, 8 to 21 in. diameter, in Great Bend, Kan.

BIDS: Eight bids were opened in August, 1937, with alternative proposals submitted for vitrified clay, and reinf. concrete pipe. Bids ranged from a low of $36,110 for vitrified clay pipe, and $37,437 for reinforced concrete pipe to respective highs of $46,599 and $48,642. Contract was awarded at $37,331 based on the use of 8 and 10 in. clay pipe and 12, 15, 18 and 21 in. reinf. concrete pipe.

LOW BIDDERS:

1. Stamey & Tidd, Hutchinson, Kan.
   - Vitrified clay pipe $36,110
   - Reinforced concrete pipe 37,437
   - 8 and 10 in. clay; bal. conc. (contract) ... 37,331
2. W. B. Carter, Wichita, Kan.
   - Vitrified clay pipe 37,180
   - Reinforced concrete pipe 38,805
   - 8 and 10 in. clay; bal. concrete 38,745
3. P. P. Young, St. Joseph, Mo.
   - Vitrified clay pipe 38,221
   - Reinforced concrete pipe 37,471
   - 8 and 10 in. clay; bal. concrete 37,915

Item	Quan.	Unit Prices (1)	(2)	(3)
1. Trenching, 4 ft.–6 ft.	15,930 l. f.	$0.24	$0.18	$0.15
2. Trenching, 6 ft.–8 ft.	6,390 l. f.	.27	.24	.18
3. Trenching, 8 ft.–10 ft.	800 l. f.	.41	.50	.245
4. Trenching, 10 ft.–12 ft.	500 l. f.	.43	1.00	.40
5. Trenching, 12 ft.–14 ft.	l. f.	.60	1.50	.65
6. V. c. pipe, 8 in.	10,850 l. f.	.39	.43	.50
7. V. c. pipe, 10 in.	325 l. f.	.56	.65	.65
8. V. c. pipe, 12 in.	1,860 l. f.	.73	.84	.84
9. V. c. pipe, 15 in.	3,357 l. f.	1.10	1.18	1.27
10. V. c. pipe, 18 in.	4,387 l. f.	1.55	1.65	1.72
11. V. c. pipe, 21 in.	2,721 l. f.	2.10	2.25	2.33
12. V. c. wyes, 8x6 in.	300 ea.	.70	.70	.80
13. V. c. wyes, 12x6 in.	60 ea.	1.30	1.20	1.25
14. V. c. wyes, 15x6 in.	75 ea.	1.63	1.75	2.00
15. V. c. wyes, 18x6 in.	86 ea.	2.22	2.75	2.50
16. V. c. wyes, 21x6 in.	ea.	4.00	3.50	3.40
17. P. c. pipe, 8 in.	10,850 l. f.	.39	.43	.46
18. P. c. pipe, 10 in.	325 l. f.	.50	.65	.62
19. R. c. pipe, 12 in.	1,860 l. f.	.88	1.00	.84
20. R. c. pipe, 15 in.	3,357 l. f.	1.31	1.35	1.27
21. R. c. pipe, 18 in.	4,387 l. f.	1.62	1.75	1.70
22. R. c. pipe, 21 in.	2,721 l. f.	2.10	2.35	2.25
23. P. c. wyes, 8x6 in.	300 ea.	1.12	0.90	0.80
24. R. c. wyes, 12x6 in.	60 ea.	1.20	1.50	1.25
25. R. c. wyes, 15x6 in.	75 ea.	1.25	2.00	1.90
26. R. c. wyes, 18x6 in.	86 ea.	1.80	2.25	2.50
27. R. c. wyes, 21x6 in.	ea.	3.00	3.75	3.40
28. C. i. pipe, 18 in.	104 l. f.	8.15	6.00	8.25
29. C. i. pipe, 20 in.	16 l. f.	10.00	7.00	9.50
30. Shallow brick manholes	15 ea.	40.00	42.00	47.00
31. Brick manholes	41 ea.	40.00	42.00	47.00
32. Variation, manhole depths	50 l. f.	5.00	5.00	5.75
33. Brick flush tanks	17 ea.	70.00	80.00	88.00
34. Variation, flush tank depths	10 l. f.	6.00	6.00	5.75
35. Shallow flush tanks	1 ea.	70.00	80.00	86.00
36. Lampholes	1 ea.	5.00	7.00	7.50
37. Supply lines, copper, ¾-in.	3,300 l. f.	.30	.25	.20
38. Regulator, stop cock	18 set	6.00	6.00	7.00
39. Corporation	5 ea.	4.00	3.00	2.50
40. Remove, replace bit. pavt.	10 s. y.	2.50	3.00	1.00
41. Remove,replacebrick pavt.	33 s. y.	2.25	5.00	4.00
42. Concrete, Cl. 3	100 c. y.	10.00	10.00	13.00
43. Reinf. steel	8,000 lb.	.05	.06	.055

MISSISSIPPI RIVER DIKES

OWNER: U. S. Engineer Dept., St. Louis, Missouri; Lt. Col. P. S. Reinecke, District Engineer.

PROJECT: Construction of 3,300 lin. ft. of piling dikes in the Mississippi River at Ste. Genevieve, Ill. and Mo., and 1,300 lin. ft. of bank protection at Greenfield Bend-Hurricane Field.

BIDS: Four bids were received on the piling dikes and three on the bank protection in August, 1937, with completion scheduled for the former at 140 days, and the latter 45 days, and minimum hourly wages stipulated at $1.10 for skilled and 50c. for common labor. Proposals ranged from $77,880 to $88,175 for the dikes, and from $36,590 to $42,968 for the bank protection.

LOW BIDS:

I. Piling Dikes—Ste. Genevieve:
1. Patton Tully Transportation Co., Memphis, Tenn. $77,880
2. Woods Bros. Const. Co., Lincoln, Neb. 81,605
3. R. B. Potashnick, Cape Girardeau, Mo. 82,325

II. Bank Protection—Greenfield-Hurricane:
1. Woods Bros. Const. Co., Lincoln, Neb. $36,590
2. R. B. Potashnick, Cape Girardeau, Mo. 40,448
3. Badgett Const. Co., Memphis, Tenn. 42,968

I. PILING DIKES—STE. GENEVIEVE. (3,300 L. F.)

Items	Quan.	Unit Prices (1)	(2)	(3)
1. Lumber mattress	210 M.b.m.	$55.00	$61.00	$70.00
2. Stone, mattress, dike	4,400 c. y.	2.75	2.70	3.00
3. Stone, hand paving	250 c. y.	5.25	4.95	5.00
4. Stone, cast paving	250 c. y.	3.25	2.95	3.50
5. Stone, crushed	200 c. y.	3.25	2.95	3.50
6. Timber piles, round	105,000 l. f.	.435	.45	.43
7. Pile stringers	11,000 l. f.	.48	.60	.55
8. Grading	2,000 c. y.	.25	.25	.20

II. BANK PROTECTION—GREENFIELD-HURRICANE. (1,300 L. F.)

		Unit Prices (1)	(2)	(3)
1. Lumber mattress	178 M.b.m.	$54.00	$70.00	$70.00
2. Stone, mattress	1,600 c. y.	2.70	3.10	3.40
3. Stone, hand paving	1,700 c. y.	4.80	4.10	4.70
4. Stone, cast paving	1,700 c. y.	3.05	3.50	3.90
5. Stone, crushed	1,100 c. y.	3.20	3.50	3.50
6. Timber piles, round	7,800 l. f.	.39	.50	.51
7. Grading	13,100 c. y.	.21	.18	.20

PORT HURON BRIDGE, MICH.

OWNER: State Highway Dept, Port Huron, Michigan.

PROJECT: Construction of Michigan approach superstructure of International Bridge over St. Clair River, between Port Huron, Mich. and Point Edward, Ont.

BIDS: Five bids were opened and contract awarded in August 1937, with proposals ranging from the contract low of $386,576 to a high of $434,545, based on minimum hourly wage rates stipulated at $1.25 for skilled and 50c. for common labor.

LOW BIDDERS:

1. Wisconsin Bridge & Iron Co., Milwaukee, Wis. (contract) $386,576
2. Bethlehem Steel Co., Bethlehem, Pa. 391,136
3. American Bridge Co., Detroit, Mich. 416,024

Item	Quan.	Unit Prices (1)	(2)	(3)
1. Structural steel	4,814,000 lb.	$0.064	$0.0635	$0.07
2. Concrete roads, walks	2,024 c. y.	18.00	20.00	19.00
3. Cement	3,299 bbl.	2.10	2.03	2.10
4. Steel reinforcing	584,000 lb.	.0425	.045	.043
5. Precast traffic markers	2,300 l. f.	1.00	1.30	.2625
6. Field paint steel	L. S.	8,000.00	9,000 00	7,944.00

(*Additional Contract Unit Prices on second following page*)